Southcentral Foundation

Yagheli Shesh Qenq'a

Roof Replacement & Mechanical Upgrades

PROJECT MANUAL

65% Design Development

REVISION 1

Where would we put the idea of signage to alert all of the conduit directly under deck? Is it an architectural sign? Or is it an electrical sign? Please point me to where we have addressed this in these specs. Thanks!

Updated - MAY 11, 2026

NEESER CONSTRUCTION, INC. | ReidMiddleton | RSA Engineering | NF ARCHITECTURE

THIS DOCUMENT IS FORMATTED FOR TWO-SIDED PRINTING

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THE FOLLOWING SECTIONS WERE PREPARED BY SOUTHCENTRAL FOUNDATION:

ALL OF DIVISIONS 0 AND 1, EXCEPT AS OTHERWISE NOTED BELOW.

THE FOLLOWING SECTIONS WERE PREPARED BY NORTHFORM ARCHITECTURE:

02 41 00

05 52 13

05 53 05

06 10 53

ALL OF DIVISIONS 7 - 10

THE FOLLOWING SECTIONS WERE PREPARED BY REID MIDDLETON:

03 20 00

03 30 00

05 12 00

05 31 00

05 40 00

06 16 00

THE FOLLOWING SECTIONS WERE PREPARED BY RSA ENGINEERING INC.:

ALL OF DIVISIONS 21 – 23 AND 26 – 28, EXCEPT AS OTHERWISE NOTED BELOW.

THE FOLLOWING SECTIONS WERE PREPARED BY RESPEC:

01 91 13

01 9 19.43

22 08 00

23 08 00

26 08 00

END OF SECTION

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Work Summary

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

1.03 WORK UNDER OWNER'S SEPARATE CONTRACTS (NOTE 1.03 SUBSECTION ADDED VIA BLUEBEAM STUDIO COMMENT, RFP EXHIBIT G DOES NOT CONTAIN SUBSECTION 1.03)

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.01 WORK COVERED BY CONTRACT DOCUMENTS

A. Work Summary:
Contractors will review existing conditions and prepare a bid for the Yagheli Shesh Qenq'a Roof Replacement & Mechanical Upgrades based on the information contained in this Project Manual and the Drawings dated _____ and Specifications dated _____. Additionally, the contractor shall comply with all administrative requirements of the contract, including the submission of a Contractor's Construction Schedule, safety plan, Schedule of Values, daily reports, Submittals, and other deliverables required under the contract.

3.02 METHOD

A. Construct the Work under a Guaranteed Maximum Price contract.

3.03 WORK BY OWNER

A. Not Applicable

3.04 CONTRACTOR'S USE OF PREMISES

A. The Southcentral Foundation Campus and the Yagheli Shesh Qenq'a is a Tobacco Free campus. No smoking is permitted on the campus or in any Areas of Work.

B. The Contractor will coordinate with SCF for area of use.

C. Limit use of premises for the Work and for storage to allow for:
   1. Owner occupancy.
   2. Public use.
   3. Coordinated use of premises under direction of Owner.
   4. Full responsibility for protection and safekeeping of products under this Contract stored at Project Site.
   5. Moving any stored products, under Contractor's control, which interfere with operations of Owner or separate Contractor(s).

D. Obtain and pay for use of any additional storage or work areas needed for operations.

3.05 OWNER'S OCCUPANCY

A. The Owner will continue to occupy and operate the Yagheli Shesh Qenq'a. The Contractor shall coordinate with the Owner to allow normal operations to continue.
B. Contractor shall schedule and coordinate with the Yagheli Shesh Qenq'a, any work which could interfere with the Owner operations.
C. Cooperate with the Owner in construction operations to minimize conflict and to facilitate Owner usage.
D. After substantial completion, schedule work to maintain Owner's operation. Include in contract sum sufficient funds as may be required for any "after hours" work caused by this requirement. No additional payment to Contractor will be authorized because of Contractor's failure to anticipate required "after hours work".
E. Contractor shall conduct operations to ensure the least inconvenience to staff, visitors, and the public.

3.06 EXCESSIVE NOISE

A. Minimize noise during Owner's normal working hours. Notify Owner at least 72 hours prior to noisy operations.

3.07 USE OF OWNER'S PROPERTY AND EQUIPMENT

A. Use of Owner's property or equipment such as tools, ladders, furniture, janitorial equipment and supplies etc., is strictly prohibited.

END OF SECTION

SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 01 11 00 - Summary of Work

C. Section 01 26 00 - Contract Modification Procedures

D. Section 01 30 00 – Administrative Requirements

E. Section 01 60 00 - Product Requirements

F. Section 01 70 00 – Execution and Closeout Requirements

1.02 SCHEDULE OF VALUES

A. Coordinate with Contractor's construction schedule and Application for Payment.

B. Submit typed Schedule of Values using form AIA G703-1992 for Bid-Build projects, AIA G743 for Design-Build projects, or alternate form pre-approved by Owner.

C. Submit Schedule of Values to the Architect, Owner, and Owner's Representative as soon as possible, but no later than 20 days after Notice to Proceed for Construction has been issued.

D. Format: When using a pre-approved, non-AIA G702-1992 form for a Schedule of Values, the format shall be as follows: Utilize the Table of Contents of this Project Manual and include other significant work items. At a minimum, rough-in and finish work shall be broken out separately.
   1. Identify each line item with number and title of the Specification Section. Identify site mobilization, bonds, and insurance.
   2. Tabular form indicating:
      a. Related Specification Section or Division.
      b. Description of 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.
    1) Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.
4. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where an Application 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. Include requirements for insurance and bonded warehousing, if required.
6. Margins of Cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin 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 the Contractor's option.
7. Schedule Updating: Update and resubmit the Schedule of Values prior to the next Application for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

E. Include within each line item, a directly proportional amount of Contractor's overhead and profit.

F. Provide sub schedule for each separate stage of work specified in Section 01 11 00 - Summary of Work.

G. Revise schedule to list approved Change Orders, with each Application for Payment.

1.03 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect (or Owner on Design-Build Projects) and paid for by the Owner.
   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment-Application Times: Each progress-payment date is indicated in the Agreement. The period of construction Work covered by each Application for Payment is the period indicated in the General Conditions.

C. Payment Application Form: Use AIA Document G702-1995 and Continuation Sheets G703-1992 or alternative form pre-approved by Owner.

D. Application Preparation: Complete every entry on the form. Include notarization and execution by a person authorized to sign legal documents on behalf of the Contractor. The Architect (or Owner if project is Design-Build) will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values and the Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

E. Transmittal: Submit 1 completed, signed, and notarized copy of each Application for Payment to the Architect (or Owner if a Design-Build Project) by a method pre-approved by the Owner, including waivers of lien and similar attachments, when required by contract.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Architect and Owner.

F. Initial Application for Payment: Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment, include the following:
   1. List of subcontractors.
   2. List of principal suppliers and fabricators.
   3. Approved Schedule of Values.
   4. Contractor's Construction Schedule (preliminary if not final).
   5. Submittal Schedule (preliminary if not final).
   6. Certificates of insurance and insurance policies.

G. Applications for Progress Payments
   1. Payment Period: Submit at intervals stipulated in Contract.
   2. Electronic media printout including equivalent information will be

considered in lieu of standard form specified: submit sample to Architect for approval.

3. Submit Applications for Payment on an approved form per the Contract and this specification.
4. For each item, provide a column for listing each of the following:
   a. Item Number.
   b. Description of work.
   c. Scheduled Values.
   d. Previous Applications.
   e. Work in Place and Stored Materials under this application.
   f. Authorized Change Orders.
   g. Total Completed and Stored to Date of Application.
   h. Percentage of Completion.
   i. Balance to Finish.
   j. Retainage, if applicable (see contract).
5. Execute certification by signature of authorized officer and notarize payment applications.
6. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
7. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
8. Submit Application for Payment utilizing Owner's project information management software, or in a manner agreed upon by Owner.
9. Include the following with the application:
   a. Construction Progress Schedule; revised and current as specified in Section 01 32 00 Construction Progress Documentation.
10. When Architect or Owner requires substantiating information, submit data justifying dollar amounts in question. Provide data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

H. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment.
   1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
   2. Administrative actions and submittals that shall precede or coincide with this application include those required for Substantial Completion as outlined in Section 01 70 00 Execution and Closeout Requirements.

I. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment

including Section 01 70 00 - Execution and Closeout Requirements and Section 01 78 00 – Closeout Submittals.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 23 00
ALTERNATES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

1.03 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.04 SCHEDULE OF ALTERNATES

A. Alternate No. ____ - _____:
   1. Base Bid Item: Section _____ and Drawing number ____ including _____.
   2. Alternate Item: Section _____ and Drawing number ____ including _____.

B. Alternate No. ____ - _____:
   1. Base Bid Item: Section _____ and Drawing number ____ including _____.
   2. Alternate Item: Section _____ and Drawing number ____ including _____.

C. Alternate No. ____ - _____:
   1. Base Bid Item: Section _____ and Drawing number ____ including _____.
   2. Alternate Item: Section _____ and Drawing number ____ including _____.

D. Alternate No. ____ - _____:
   1. Base Bid Item: Section _____ and Drawing number ____ including _____.

2. Alternate Item: Section _____ and Drawing number ____ including _____.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 012300 - Alternates, for product alternatives affecting this section.

C. Section 013000 - Administrative Requirements: Submittal procedures, coordination.

D. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

B. Substitutions: See General Conditions for definition.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
2. Agrees to provide the same warranty for the substitution as for the specified product.
3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
5. Waives claims for additional costs or time extension that may subsequently become apparent.
6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. Documentation: Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on Contractor.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. No specific form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Request date.
         4) Reference to particular Contract Document(s) specification section number, title, article/paragraph(s), and/or sheet number, drawing number, drawing title, etc.
         5) Description of Substitution.
         6) Reason why the specified item cannot be provided.
         7) Differences between proposed substitution and specified item.
         8) Description of how proposed substitution affects other parts of work.
      c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
         1) Physical characteristics.
         2) In-service performance.
         3) Expected durability.
         4) Visual effect.
         5) Sustainable design features.

6) Warranties.
7) Other salient features and requirements.
8) Include, as appropriate or requested, the following types of documentation:
(a) Product Data:
(b) Samples.
(c) Certificates, test, reports or similar qualification data.
(d) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:
1) Savings (or additional cost) to Owner for accepting substitution.
2) Change to Contract Time due to accepting substitution.

D. Quantity/ Limitation: Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document, to the Architect and Owner.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

E. Submittal Time Restrictions:
1. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

3.03 SUBTITUTION PROCEDURES DURING CONSTRUCTION

F. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to the time required for revi3ew and approval by Architect, in order to stay on approved project schedule.

G. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect and Owner, in order to stay on approved project schedule.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
a. Owner’s compensation to the Architect for any required redesign, time spent processing and evaluating the request.

H. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.

3.04 RESOLUTION

I. Architect or Owner may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

J. Architect will notify Contractor in writing of decision to accept or reject request.
   1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

K. Accepted substitutions change the Work of the Project. They will be documented and incorporated into Work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

L. See Section 017800 - Closeout Submittals, for closeout submittals requirements.

M. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected requests.

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for documenting and processing contract modifications.

1.02 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 01 20 00 – Price and Payment Procedures.

C. Section 01 60 00 - Product Requirements.

D. Section 01 70 00 – Execution and Closeout Requirements.

1.03 SUBMITTALS

A. Submit name of the individual authorized to receive change documents and be responsible for informing others in contractor's employ or subcontractors of changes to the Work.

B. Proposal Form (for proposed change): AIA Document G709-2018 or another form acceptable to Owner.

C. Change Order Form: AIA Form G701-2017 - Change Order or other form acceptable to Owner.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT SUM AND CONTRACT TIME

A. Maintain detailed records of work done on a time and materials basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.

C. On request, provide additional data to support computations:
   1. Quantities of products, labor, and equipment.
   2. Taxes, insurance and bonds.
   3. Overhead and profit.
   4. Justification for any change in Contract Time.
   5. Credit for deletions from Contract, similarly documented.

D. Support each claim for additional costs and for work done on a time and materials basis, with additional information:
   1. Origin and date of claim.
   2. Dates and times work was performed, and by whom.
   3. Time records and wage rates paid.
   4. Invoices and receipts for products, equipment and subcontracts, similarly documented.

1.05 CHANGE PROCEDURES

A. Architects Supplemental Instructions: The Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time, by issuing supplemental instructions on AIA Form G710-2017 - Architect's Supplemental Instructions.

B. Proposal Request: The Owner may issue a Proposal Request (AIA Document G709 or form acceptable to Owner) which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid.

C. Change Proposal: The Contractor may propose a change by submitting a request for change to the Owner, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 016000 – Product Requirements.

D. It is the Owners decision whether a change directive is stipulated sum, unit price, or time and materials.

1.06 CONSTRUCTION CHANGE AUTHORIZATION

A. Architect or Owner may issue a document, signed by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

   1. The document will describe changes in the Work and will designate the method of determining any change in Contract Sum or Contract Time.

   2. Promptly execute the change in Work.

1.07 STIPULATED SUM CHANGE ORDER

A. Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by the Owner.

1.08 TIME AND MATERIAL CHANGE ORDER

A. Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

B. Maintain detailed records of work done on time and materials.

C. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

1.09 EXECUTION OF CHANGE ORDERS

A. Architect or Owner's Representative may prepare Change Orders for signatures of Owner, Contractor, and Architect as provided in the Conditions of the Contract, Article 7.

1.10 CORRELATION OF CONTRACTOR SUBMITTALS

A. Promptly revise Schedule of Values and Application for Payment Forms to record each authorization Change Order as a separate line item and adjust the Contract Sum.

B. Promptly revise Construction Progress Schedules to reflect any change in Contract Time, revise sub-schedules to adjust time for other items of work affected by the change, and resubmit.

C. Promptly enter changes in Project Record Documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Accident Prevention Plan.
C. Preconstruction meeting.
D. Progress meetings.
E. Construction progress schedule.
F. Progress photographs.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Information (RFI) procedures.
J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.
B. Section 016000 - Product Requirements.
C. Section 017000 - Execution and Closeout Requirements.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information 2004.
B. AIA G810 - Transmittal Letter 2001.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Utilize SCF's Autodesk Construction Cloud (ACC) project management site for tracking and memorialization of all meeting agendas/minutes, submittals, RFI's ASI's, posting of drawings/specifications, document filing, and for all other project document tracking, as directed by the Owner.
C. Make the following types of submittals to Architect:

1. Requests for Interpretation (RFI).
2. Requests for substitution.
3. Shop drawings, product data, and samples.
4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

1.05 ACCIDENT PREVENTION PLAN

A. Plan Overview
   1. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Prime Contractor is considered to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.

B. Plan Content
   1. Include and address in the APP the following, at a minimum.
      a. Type of Project/ Project Description
      b. Scope of Work
      c. Contact Information
      d. Identification of person(s) responsible for safety at the project location and lines of authority
      e. Project Location
      f. Geographic Risks
      g. Site drawings and hazard locations: Contractor’s site safety plan, including mustering point, location of nearest hospital/ emergency clinic, vehicular and pedestrian traffic flow graphics, site security checkpoints, area of work limits/fencing, etc., at a minimum.
      h. Procedures to avoid hazards (in the form of Activity Hazard Analysis and Work Plan, as needed, for each unique task where hazards exist).
         1) Crane work, confined space entry, scaffolding, walking and working surfaces including fall protection, and other specialized work shall require a separate and specific Work Plan to address the unique risks and hazards associated with the work.

i. Security risks and securing of supplies and the worksite.
j. Safety check schedule
k. Safety orientation for new workers and visitors to the site and accident notification process to Owner.
l. Accident notification and investigation process
m. PPE Guidelines
n. Safety Training
o. First Aid Locations
p. Hazard communication plan
q. All content required by OSHA and AHJs
r. Signature sheet signed by an Officer of the company and the Responsible Person onsite

C. Plan Approval
1. Submit APP for Owner's approval a minimum of 3 weeks prior to any work being performed.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Architect.
3. Contractor.
4. Owner's Representative (if applicable).

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. PCRA-ICRA Overview
5. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
6. Submission of initial Submittal schedule.
7. Designation of personnel representing the parties to Contractor, Owner, Architect, and Owner's Representative (if applicable).
8. Guidelines for working in SCF properties.
9. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, change orders, and contract closeout procedures.
10. Scheduling.

D. Record minutes and distribute copies electronically to Architect, Owner, Owner's Representative (if applicable), participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with electronic copies for participants (to be distributed 24 hours prior to meeting), preside at meetings.

C. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Special consultants.
   5. Contractor's superintendent.
   6. Major subcontractors.

D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems that impede, or will impede, planned progress.
   5. Review of submittals schedule and status of submittals.
   6. Review of RFIs log and status of responses.
   7. Maintenance of progress schedule.
   8. Corrective measures to regain projected schedules.
   9. Planned progress during succeeding work period.
   10. Coordination of projected progress.
   11. Maintenance of quality and work standards.
   12. Effect of proposed changes on progress schedule and coordination.
   13. Other business relating to work.

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

3.03 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated construction schedule with each Application for Payment.

3.04 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Photography Type: Digital; electronic files.

C. Provide high quality digital photographs of site and construction throughout progress of work, using the ACC photo application.

D. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Excavations in progress.
   2. Foundations in progress and upon completion.
   3. Structural framing in progress and upon completion.
   4. Enclosure of building, upon completion.

3.05 REQUESTS FOR INFORMATION (RFI)

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

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare in a format and with content acceptable to Owner.
      a. Use AIA G716-2004 - Request for Information to be submitted in ACC.

3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 016000 - Product Requirements)
      c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
      d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.

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

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

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.

1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.

H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt, excluding SCF recognized holidays. For the purpose of establishing the start of the mandated response period, RFIs received after 2:00PM (Owner's local time) will be considered as having been received on the following regular working day.
   1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
   2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
   3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
   4. Notify Architect within seven calendar days, excluding SCF recognized holidays, if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.06 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Format schedule to allow tracking of status of submittals throughout duration of construction.
   2. Account for time required for preparation, review, manufacturing, fabrication, and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.07 SUBMITTALS FOR REVIEW

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

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

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

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017000 – Execution and Closeout Requirements.

3.08 SUBMITTALS FOR INFORMATION

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

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.11 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a separate transmittal for each item.
   2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   3. Transmit using approved form.
      a. Use Form AIA G810-2001.
   4. Identify each item based on applicable specification section. For revised submittals use original number and a sequential numerical suffix.
   5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
   7. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 14 calendar days, excluding SCF recognized holidays.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 calendar days.
      c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 calendar days.
   8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   9. Provide space for Contractor and Architect review stamps.
   10. When revised for resubmission, identify all changes made since previous submission.
   11. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.

12. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work and have received prior approval for their use.
13. Submittals not requested will not be recognized or processed.

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

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
   2. Do not reproduce Contract Documents to create shop drawings.
   3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
   1. Transmit related items together as a single package.
   2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.12 SUBMITTAL REVIEW

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

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

D. Architects’ and consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Approved", or language with same legal meaning.
      b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit".
      b. "Rejected".

E. Architects’ and consultants' actions on items submitted for information:
   1. Items for which no action was taken:
      a. "Received" - to notify the Contractor that the submittal has been received for record only.
   2. Items for which action was taken:
      a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.
B. Section 01 30 00 – Administrative Requirements
C. Section 01 70 00 – Execution and Closeout Requirements

1.02 DEFINITIONS

A. Request for Information (RFI): Request from Owner, Architect, or Contractor seeking information required by a clarification of the Contract Documents.

B. Architect's Supplemental Instructions (ASI): Information provided by Architect to clarify scope of work in Contract Documents.

1.03 PROJECT SCHEDULE

A. Provide a project schedule for approval by the Architect and Owner prior to starting work. The Project Schedule shall use the Critical Path Method "CPM" or other Owner approved method. The Schedule shall have adequate detail that provides information on the planned work and tasks and shall be relationship driven using either predecessor or successor relationships. The schedule shall be updated and submitted with every Application for Payment, and uploaded to Autodesk Construction Clout (ACC).

1.04 COORDINATION

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

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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. Startup and adjustment of systems.
   8. Project closeout activities.

D. 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. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.05 COORDINATION DRAWINGS

A. General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, 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.
   1. 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 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.
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. 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.

1.06 KEY PERSONNEL

A. 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 email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, on Project Website**,** and by each temporary telephone. Keep list current at all times.

1.07 PROJECT MEETINGS

A. General: Contractor will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   Meeting agendas and notes shall utilize Autodesk Construction Cloud (ACC) software.
   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 two days of the meeting.

B. Preconstruction Conference: Contractor will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 20 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 and ASIs.
      h. Procedures for testing and inspecting.
      i. Procedures for processing Applications for Payment.
      j. Distribution of the Contract Documents.
      k. Submittal procedures.
      l. Sustainable design requirements.
      m. Preparation of record documents.
      n. Use of the premises [and existing building if applicable].
      o. Work restrictions.
      p. Working hours.
      q. Owner's occupancy requirements.
      r. Responsibility for temporary facilities and controls.
      s. Procedures for moisture and mold control.
      t. Procedures for disruptions and shutdowns.
      u. Construction waste management and recycling.
      v. Parking availability.
      w. Office, work, and storage areas.
      x. Equipment deliveries and priorities.
      y. First aid.
      z. Security.
      aa. Progress cleaning.

C. Pre-installation Conferences: Conduct a pre-installation 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 activity under consideration, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related RFIs and ASIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility problems.
   k. Time schedules.
   l. Weather limitations.
   m. Manufacturer's written recommendations.
   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. Progress and Coordination Meetings: Contractor will conduct progress meetings at appropriate intervals.
   1. Coordinate dates of meetings with preparation of payment requests.
   2. Attendees: 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 and RFI's
        4) Off-site fabrication and deliveries.
        5) Site access and utilization.
        6) Temporary facilities and controls.
        7) Progress cleaning.
        8) Quality and work standards.
        9) Status of correction of deficient items.
        10) Field observations.
        11) Status of proposal requests.
        12) Pending changes.
        13) Status of Change Orders.
        14) Pending claims and disputes.
        15) 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.

E. Project coordination meetings are to be held weekly. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.
B. Section 013000 - Administrative Requirements: Submittal procedures.
C. Section 014200 - Reference Standards and Definitions.
D. Section 016000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. Note: If a newer version of any reference standard exists, the newer version shall be incorporated and followed in lieu of the older version referenced herein.
B. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants 2008 (Reapproved 2023).
C. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation 2017.
D. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry 2022a.
E. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction 2019.

F. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2021.

G. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing 2021.

H. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components 2016.

I. IAS AC89 - Accreditation Criteria for Testing Laboratories 2021.

1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Test Reports: After each test/inspection, promptly submit one electronic copy of report to Architect, Owner, and Owner’s Representative.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.

C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, as specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

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

E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner/ Owner’s Representative.

1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.06 QUALITY ASSURANCE

A. Contractor's Quality Control (CQC) Plan:
   1. Thirty days prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
      a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
      b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
         1) Management and control of documents and records relating to quality.
         2) Communications.
         3) Coordination procedures.
         4) Resource management.
         5) Process control.
         6) Inspection and testing procedures and scheduling.
         7) Control of noncomplying work.
         8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
         9) Control of testing and measuring equipment.
         10) Project materials certification.
         11) Managerial continuity and flexibility.
      c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
      d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

B. Quality-Control Personnel Qualifications. Engage a qualified person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project. QC personnel may be subject to SCF approval.

1.07 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.08 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to inspect against and to determine the acceptability of Work yet to be completed.

C. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

E. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

F. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect. Confirm with Architect and Owner prior to removal of mock-up.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:

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

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

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

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

3.05 MANUFACTURERS' FIELD SERVICES

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

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

3.06 DEFECT ASSESSMENT

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

END OF SECTION

SECTION 01 40 10
CLEAN CONSTRUCTION PROCEDURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Clean Construction procedures, policies, and best practices and requirements.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

1.03 PURPOSE

A. To outline the process for selecting and implementing proper controls to reduce risk and to minimize impact of construction or renovation activities throughout Southcentral Foundation (SCF) facilities.

1.04 SCOPE

A. This applies to all direct hire employees, Civil Service and Commissioned Corps Officers working under contractual agreements with Southcentral Foundation (SCF) and volunteers. Individuals and business entities that have entered into contractual agreements with Southcentral Foundation (SCF) are not exempt, unless otherwise stated in their contracts.

1.05 DEFINITIONS

A. Customer-owner: Individuals who seek and receive services at SCF's programs and departments. The following terms may be used by SCF programs and departments in referring to customers:
   1. Patients
   2. Residents
   3. Students
   4. Members
   5. Beneficiaries
   6. Guests
   7. Event Participants
   8. Clients

B. Infection Control Risk Assessment (ICRA) – A risk assessment tool that incorporates the facility's customer-owner population and type of construction work to reduce the risk of infection through phases of facility planning, design, construction, renovation, and maintenance.

1.06 PROCEDURE

A. The Clean Construction Procedure with the accompanying Infection Control Risk Assessment (ICRA) Construction Permit will apply to all projects, including small construction and maintenance work.

B. The ICRA will be implemented in the planning phase of each project and will be assessed by the Manager of Facilities or designee, in consultation with the Project Manager, Safety Manager and Quality Assurance (QA) Nurse Manager or designee.

C. The Manager of Facilities or designee will provide updated documentation of the risk assessment throughout planning, design, and construction.

D. Performance Standards
   1. ICRA will be initiated and maintained by the Manager of Facilities or designee, in consultation with the QA Nurse Manager or designee, and Safety Manager at all appropriate construction sites and areas with Infection Control (IC) deficiencies.
   2. Selected ICRA will be monitored by the Manager of Facilities in consultation with the QA Nurse Manager or designee, Safety Manager and Security Officers on weekends and holidays.
   3. The Manager of Facilities or designee, will provide briefings to the affected employees, including construction workers, to inform the staff of the particular ICRA for areas where they work.

E. Manager of Facilities Responsibilities:
   1. The Manager of Facilities in consultation with the QA Nurse Manager or designee and the Safety Manager will select and implement appropriate infection control measures/actions for existing hazards that violate infection control standards and/or guidelines.
   2. The Manager of Facilities or designee will ensure the ICRA measures/actions are maintained and enforced.
      a. The Manager of Facilities or designee will consult with the QA Nurse Manager or designee and the Safety Manager for all Type C and Type D projects as defined in this procedure.
   3. The Manager of Facilities or designee will ensure that ICRA measures/actions are incorporated into all contractor negotiations and contracts.
   4. The Manager of Facilities or designee will ensure that contractors and maintenance employees adhere to the implemented ICRA measures/actions.
   5. Contractors are responsible for training their employees and enforcing ICRA measures/actions with their employees.
   6. Employees are responsible for adhering to established ICRA measures/actions and for reporting any violations of this procedure to the Manager of Facilities or designee.

F. Project Assessment

1. Each project will be assessed for risk during the planning phase by Facilities.
   a. The project will be assigned a risk group to include employees from Corporate QA, Facilities, and the affected program and will be matched with a project type that will determine a class of precautions to be implemented.
2. The class of precautions will be determined by using the Type of Work Matrix described in this procedure.
3. Type of Projects (Work)
   a. Type A (Minor) - Inspection and non-invasive projects including, but not limited to:
      a) Removal of ceiling tiles for visual inspection
      b) Painting with no sanding
      c) Wall covering
      d) Electrical trim work
      e) Minor plumbing and
      f) Other activities that do not generate dust
   b. Type B (Maintenance) – Short duration / minimal dust projects which include, but are not limited to:
      a) Setting brackets
      b) Hanging items
      c) Cutting of walls or ceilings where dust migration can be controlled to the immediate work area and the duration is less than one (1) work shift
      d) Cutting of walls or ceilings where dust migration can be controlled, and the duration is less than one (1) work shift
   c. Type C (Moderate) – Short duration / minor dust projects, including, but is not limited to:
      a) Sanding
      b) Removal of floor coverings, ceiling tiles, and casework
      c) New wall construction
      d) Minor duct work or electrical work above the ceiling
      e) Major cabling activities
   d. Type D (Major) – Projects that generate dust or require demolition of fixed building components which include, but are not limited to:
      a) Activities which require consecutive work shifts
      b) Require heavy demolition and/or removal of a complete cabling system
      c) New construction
4. Type of Area
   a. Low Risk:

a) Plant area and other areas not intended for customer-owner use
b) Warehouse
c) Office areas

b. Medium Risk:
a) Physical Therapy
b) Radiology
c) Outpatient Clinics (not including office areas)
d) Dental Clinics
e) Pharmacy
f) Employee Family Center
g) Living quarters at residential treatment programs
h) Food service or kitchen areas

c. High Risk:
a) Endoscopy
b) Laboratory

d. Highest Risk
a) Dental Sterile Processing

5. Risk Group Classifications

Risk Group Classification	Type A	Type B	Type C	Type D
Low Risk	I	I/II	II	III/IV
Medium Risk	I	I/II	III	IV
High Risk	I	I/II	III/IV	IV
Highest Risk	I/II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the construction activity and risk level indicate that Class III or Class IV control procedures are necessary.

6. Infection control measure based on class:

	During Construction Project	Upon Completion of Project
Class I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace any ceiling tile displaced for visual inspection.	1. Clean work area upon completion of work.

Class II	1. Provide active means to prevent air-borne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with tape. 4. Block off and seal air vents. 5. Remove or isolate heating, ventilation, and air conditioning (HVAC) system in areas where work is being performed.	2. Wipe work surfaces with disinfectant. 3. Contain construction waste before transport in tightly covered containers. 4. Wet mop and/or vacuum with High-Efficiency Particulate Air (HEPA) filtered vacuum before leaving work area. 5. Remove isolation of HVAC system in areas where work is being performed.
Class III	1. Remove or isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within the work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid.	1. Do not remove barriers from work area until completed project is inspected by the Manager of Facilities, Safety Manger and QA Nurse Manager or designee, and is thoroughly cleaned by housekeeping. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with disinfectant. 5. Remove isolation of HVAC system in areas where work is being performed.

Class IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures appropriately. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Do not remove barriers from the work area until completed project is inspected by owner's Safety Department and Infection Control Department and thoroughly cleaned by owner's Environmental Services Department.	1. Do not remove barriers from work area until completed project is inspected by the Manager of Facilities, Safety Manager and QA Nurse Manager or designee, and is thoroughly cleaned by Environmental Services Department. 2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 3. Contain construction waste before transport in tightly covered containers. 4. Cover transport receptacles or carts. Tape covering unless solid lid. 5. Vacuum work area with HEPA filtered vacuums. 6. Wet mop area with disinfectant. 7. Remove isolation of HVAC system in areas where work is being performed.

7. Environmental monitoring:
   a. The Manager of Facilities will conduct field inspections at any time during the life of the project with the assistance of the QA Nurse Manager or designee and Safety Manager.
   b. The Manager of Facilities will monitor air quality throughout project as needed.

8. Implementation of Infection Control Measures
   a) Temporary construction barriers and closures will be dust-tight.
   b) Removal of debris will be in tightly covered containers.
   c) Adhesive walk-off mats will be placed at all entrances to work site, as needed.
   d) Any dust tracked outside of the barrier will be removed immediately.

e) Any ceiling access panels opened for investigation beyond sealed areas will be replaced immediately when unattended.
f) Block off all ventilation and return ducts within the construction area.
g) Method of capping ducts will be dust tight and airflow to those devices will be shut off (either with the direct digital control (DDC) and/or damper).
h) Removal of construction barriers and ceiling protection will be done carefully.
i) Vacuum and clean all surfaces free of dust after the removal.
j) Housekeeping will be notified to do a follow-up cleaning of the area.
k) When access panels are opened in occupied areas requiring protection, for work above ceilings, use a polyethylene enclosure around ladder, sealing off opening.
l) The device will be fitted/sealed tightly to the ceiling and floor per manufacturers' instructions.

9. Enforcement of Infection Control Measures
   a. The Manager of Facilities, QA Nurse Manager or designee, or Safety Manager may stop the work if this procedure is violated.
      a) Work will not resume until a ll violations of this procedure are corrected and verified in writing.
   b. The Manager of Facilities will record the following:
      a) Document each violation with photographs and written reports
      b) Extract contractor or department information from the work log
      c) Maintain a record of all infection control violations
   c. Violations of this procedure may affect status as a responsible contractor for bidding future work.

1.07 REFERENCES

A. Attachment A – Specification Section 01 40 10.01 – Infection Control Risk Assessment Construction Permit.

B. Facility Guidelines Institute, Guidelines for Design and Construction of Healthcare Facilities (2022).

END OF SECTION

ATTACHMENT A: PRECONSTRUCTION RISK ASSESSMENT CHECKLIST

Interim Life Safety Measures (**ILSM**) Infection Prevention and Control (**ICRA**) Interim Utility System Measures (**IUSM**)

*This form is an evaluation tool and **NOT** intended to replace required project, compliance, or safety documentation.*

Instructions: Please complete the entire form and submit to the Project Manager, SCF Facilities, and SCF Safety for review and approval. ILSM, ICRA, and IUSM approvals may require multiple steps and can take more than a week to approve, so plan accordingly. To expedite, consider attaching supporting documentation. Risk assessment should identify specific mitigation methods for each phase of the project. Utilize the clarification section to identify the applicability of additional forms (i.e. Demo higher ICRA need than finishing work)

Once approved and signed; display and hang a copy at the work site to be available upon request.

Section 1: General Project Information – ***required section*** –		**Anticipated project date range:**		**Today's Date:**	
Submitted By (name & company)		**Start Date:**		**Estimated End Date:**	
Project Manager (name & contact #):		**Impacted Department(s)** (list all that apply):			
Contractor Contact (name & contact #):		**Impacted Department(s)** Contact #:			
Appointed Site Safety Officer (name & contact #)		**Adjacent Department(s)** (list all that apply):			
Life Safety Occupancy (business, hospital, etc.):	Business	**Anticipated Accreditation or Regulatory Surveys:**			

Important Contacts:	SCF Security: 907.729.5700	SCF Safety: 907.575.8006	Infection Control: 907.570.6475

Construction Project Type Assessment – Circle Class

Risk

Each project is assessed by assigning a risk group and project type to determine infection prevention precautions required during project. Clean Construction Procedure #805-03 **Infection Control Permit and Class Procedures provided below, PM signature required.**

	Activity			
	Type A	**Type B**	**Type C**	**Type D**
LOW RISK	Class I	Class II	Class II	Class III/IV
MEDIUM RISK	Class I	Class II	Class III	Class IV
HIGH RISK	Class I	Class II	Class III/IV	Class IV
HIGHEST RISK	Class II	Class III/IV	Class III/IV	Class IV

Type A	**Type B**	**Type C**	**Type D**
Inspection and noninvasive activities such as: • Removal of ceiling tiles for visual inspection only, limited to one tile per 50 square feet • Painting (without sanding) • Wall covering replacement • Electrical trim work • Minor plumbing • Activities without dust	**Small-scale, short-duration activities that create minimal dust:** • Includes, but is not limited to: • Setting brackets • Hanging items • Cutting of walls or ceiling where dust migration can be controlled to the immediate work area and the duration is less than one shift	**Work that generates moderate to high level of dust or requires demolition, or removal of any fixed building components or assemblies:** • Removal of floor/wall coverings, ceiling tiles, or casework • Cutting walls or ceilings where dust migration can be controlled and the duration is less than one work shift • Minor duct work or electrical work above ceilings • Major or invasive cabling activities • New wall construction	**Major demolition and construction projects:** • Removal of floor/wall coverings, ceiling tiles, and casework • Cutting of walls or ceilings where dust migration can be controlled and the duration is less than one shift • Minor duct work or electrical work above ceilings • Major or invasive cabling activities • New wall construction
Low Risk Areas	**Medium Risk Areas**	**High Risk Areas**	**Highest Risk Areas**
• Plant areas • Supply areas • Office areas not near patient care • Areas not intended for patient use	• Outpatient clinics ***(not specified in high or highest risk category)*** • Cardiology • Dental • Echocardiography • Physical Therapy • Radiology/MRI • Respiratory Therapy • Outpatient Pharmacy	• Emergency Room/Fast Track • Laboratory • Maternal Child (Labor & Delivery) • Newborn Nursey • Outpatient Surgery (Day Surgery) • Inpatient Pharmacy (non-compounding) • Corridors in high risk areas	• Operating rooms; including C-Section • Central Supply/Sterile Processing Department • Intensive Care Units • Endoscopy • Negative Pressure Isolation Rooms • Oncology • Areas immune-compromised patients.

Infection Prevention & Control Requirements	Identified Risk or Hazard				Req'd	Additional info.
Evaluation Required – accredited campus	YES	NO	N/A	Completed Infection Control Risk Assessment (ICRA) – IC signature required for Class III & IV projects	ICRA/ Class	Coordinate w/ Infection Control (IC)
	YES	NO	N/A	Airborne infection isolation room(s) impacted	ICRA	Coordinate with IC and department
	YES	NO	N/A	Temporary dust-tight construction barriers	ICRA	Coordinate with IC and department
	YES	NO	N/A	Construction waste transport and disposal	ICRA	Walk-off mats, covered carts, etc.
	YES	NO	N/A	Domestic water system be impacted	ICRA	Reference ANMC procedure #801-07
	YES	NO	N/A	Potential worker exposure to infectious diseases	ICRA	Coordinate with IC and department
	YES	NO	N/A	Immune-compromised patients in area or nearby	ICRA	Coordinate with IC and department

Life Safety Requirements	Identified Risk or Hazard Select YES if any of the risks or hazards apply and proceed with requirements.				Req'd	Additional info.
Evaluation Required – accredited campus	YES	NO	N/A	Completed assessment for Interim Life Safety Measures (ILSM) – ILSM form, signatures required	ILSM	Complete ILSM assessment with required signatures.
	YES	NO	N/A	Fire alarm or sprinkler system impaired (e.g. out of service, disabled smoke detector(s) or sprinkler(s))	ILSM	Evaluate for Fire Watch and complete form as needed
	YES	NO	N/A	Alternate egress required - block or obstruct exits (exit signs, >6" corridor projections, evacuation plans)	ILSM	Review Life Safety Plans, post fire safety response plan for contractor and employees; document education
	YES	NO	N/A	Temporary smoke-tight construction partitions (e.g. occupied spaces)	ILSM	
	YES	NO	N/A	Fire or smoke barrier penetration (e.g. missing ceiling tiles, doors, walls)	ILSM	Evaluate for Fire Watch and complete form as needed
	YES	NO	N/A	Above ceiling work (i.e. penetrations, cabling, debris, broken tiles)	ILSM	Evaluate for ILSM
	YES	NO	N/A	Storage of supplies and waste required (e.g. flammable or combustible materials, debris, dust, waste)	ILSM	Evaluate for ILSM
	YES	NO	N/A	Hot work including fire or spark producing (e.g. welding, grinding metal, soldering)	ILSM	Complete hot work permit, post copy at site where work is taking place
	YES	NO	N/A	Evaluate for Fire Watch needs for project	ILSM	Evaluate for ILSM
				Structural fire proofing		Evaluate for ILSM

Utility Systems Requirements	Identified Risk or Hazard Select YES if any of the risks or hazards apply and proceed with requirements.				Req'd	Additional info.
Evaluation Required – accredited campus	YES	NO	N/A	Electricity interruptions	IUSM	Evaluate for interim utility measures (IUSM) & required coordination.
	YES	NO	N/A	Water interruptions	IUSM	Evaluate for IUSM and develop water damage prevention plan.
	YES	NO	N/A	Heating Ventilation Air Conditioning interruptions	IUSM	Evaluate for IUSM & coordination
	YES	NO	N/A	Medical gas	IUSM	Evaluate for IUSM & coordination
	YES	NO	N/A	Pneumatic Tube	IUSM	Evaluate for IUSM & coordination
	YES	NO	N/A	Suction	IUSM	Evaluate for IUSM & coordination
	YES	NO	N/A	Networking, data systems, or telecommunications	IUSM	Evaluate for IUSM & coordination
	YES	NO	N/A	Cabling – requiring pass through walls or ceilings	IUSM/ **ILSM**	Evaluate for IUSM & **ILSM**
	YES	NO	N/A	Other systems – nurse call, overhead paging,	IUSM	Evaluate for IUSM & coordination
				Potential worker exposure to infectious diseases	IUSM/ **ICRA**	Evaluate for IUSM & **ICRA**

Safety Requirements	Identified Risk or Hazard Select YES if any of the risks or hazards apply and proceed with requirements.				Req'd	Additional info.
Evaluation Required – ALL PROJECTS	YES	NO	N/A	Communication Plan (notification to construction team, impacted areas, and staff)		Post required signage and notify impacted staff
	YES	NO	N/A	Noise or vibration in area or nearby (special considerations required for NICU/Peds and inpatient areas)		Coordinate with impacted Department(s)
	YES	NO	N/A	Hazardous Materials & Waste (considerations for hazards and PPE - odors, fumes, VOC, corrosives)		Review Safety Data Sheet (SDS) & OSHA requirements, keep SDS on site
	YES	NO	N/A	Biohazardous Waste (considerations for disposal and proper PPE per OSHA 1910.1030)		Evaluate for compliance with OSHA 1910.1030 and ANMC Procedures
	YES	NO	N/A	Construction Site Safety (e.g. falling objects, tripping hazards, fall protection, PPE)		Appoint Site Safety Officer
	YES	NO	N/A	Motorized equipment (e.g. forklift, scissors lift, crane)		Evaluate for specific requirements including competency/training
	YES	NO	N/A	Relocate occupants (e.g. patients, staff, classes, meetings, etc.)		Coordinate with impacted Department(s)
	YES	NO	N/A	Confined Space entry required		Evaluate for confined space requirements per OSHA
	YES	NO	N/A	Scaffolding or working on elevated surfaces		Evaluate for fall protection requirements per OSHA

Security Requirements	Identified Risk or Hazard Select YES if any of the risks or hazards apply and proceed with requirements.				Req'd	Additional info.
Evaluation Required – accredited campus	YES	NO	N/A	Access Control (e.g. ID badge access, physical keys, disable security systems)		
	YES	NO	N/A	High Security Considerations (e.g. perimeter, medications, medical records, IT, HR files, etc.)		PM to coordinate with departments, Security, and Control Room
	YES	NO	N/A	Medication Safety and Security (i.e. unsecure doors/walls/ceilings, moving Pyxis, waste)		PM coordinate with Pharmacy/Dept.
	YES	NO	N/A	Other security measures (explain):		PM to coordinate with departments, Security, and Control Room
	YES	NO	N/A			

Additional Information or Requirements:

PCRA Signatures

Reviewed and signed by at least the Health Facilities, ANMC Safety, and Infection Control. At a minimum a copy of the signed form should be provided to the Department Director, Security, and affected areas and available at the worksite.

Facilities/ Projects print name and signature:	**Infection Control print name and signature:**
Date:	Date:
	Signature of SCF Safety (as applicable):
	Date:

Infection Control Constructions Permit – Project Requirements by Class as designated on the PCRA		
	During Project	Upon Completion of Project
Class I	• Execute work by methods to minimize raising dust from construction operations • Immediately replace a ceiling tile displaced for visual inspection	• Clean work area upon completion of task
Class II	• Provide active means to prevent airborne dust from dispersing into the atmosphere • Water mist work surfaces to control dust while cutting • Seal unused doors with duct tape • Block off and seal air vents • Place dust mat at entrance and exit of work area • Remove or isolate HVAC system in areas where work is being performed	• Wipe work surfaces with cleaner/disinfectant • Contain construction waste before transport in tightly covered containers • Wet mop and/or vacuum with high-efficiency particulate air (HEPA) filtered vacuum before leaving work area • Upon completion, restore HVAC system where work was performed
Class III	• Remove or isolate HVAC system in area where work is being done to prevent contamination of duct system • Complete all critical barriers, e.g., sheetrock, plywood, plastic to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. • Maintain negative air pressure within work site utilizing HEPA-equipped air filtration units • Contain construction waste before transport in tightly covered containers • Cover transport receptacles or carts. Tape covering unless lid is solid.	• Do not remove barriers from work area until completed project is inspected by the Infection Control or Safety Officer or representative and they are thoroughly cleaned by EVS staff. • Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. • Vacuum work area with HEPA-filtered vacuums. • Wet mop area with cleaner/disinfectant. • Upon completion, restore HVAC system where work was performed.
Class IV	• Isolate HVAC system in area where work is being done to prevent contamination of duct system. • Complete all critical barriers, e.g. sheetrock, plywood, plastic to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. • Maintain negative air pressure within work site utilizing HEPA-equipped air filtration units • Seal holes, pipes, conduits, and punctures. • Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or have them wear cloth or paper coveralls that are removed each time they leave work site. • All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.	• Do not remove barriers from work area until completed project is inspected by the Infection Control or Safety Officer or representative and they are thoroughly cleaned by EVS staff. • Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. • Contain construction waste before transport in tightly covered containers. • Cover transport receptacles or carts. Tape covering unless solid. • Vacuum work area with HEPA-filtered vacuums. • Wet mop area with cleaner/disinfectant. • Upon completion, restore HVAC system where work was performed.

Additional Information or Requirements (additional measures being taken to mitigate infection control measures):	
Infection Control print name and signature:	**Facilities/ Projects print name and signature:**
Date:	Date:

Instructions: PM to ensure the below answers are provided for each ILSM. For any "YES" answers, indicate the duration of the measure and review the, the "Implemented ILSM" column details the minimum required ILSM. Unless otherwise noted, the PM is responsible to implement all required ILSMs. Blank rows are provided to allow additional ILSMs as required for the safety of patients and staff and the preservation of the facility. ***Include drawings to show the affected area and where specific ILSMs will be implemented.*** PM to obtain proper review and approvals prior to beginning work.

Measure	ILSM Evaluation			Duration of ILSM dates/phase(s)	Implemented ILSM
1.	Will a fire alarm system be out of service for more than 4 hours in a 24-hour period?	YES	NO		Director of Facilities, or designee, will notify the fire department and other emergency response services. PM to initiate Fire Watch and document according to fire watch procedure and forms. To the extent possible the detectors will be disabled and covered during work hours but enabled during non-work hours as fully functional.
2.	Will the fire sprinkler system be out of service for more than 10 hours in a 24-hour period?	YES	NO		Director of Facilities, or designee, will notify the fire department and other emergency response services. PM to initiate Fire Watch and document according to fire watch procedure and forms.
3.	Will exit accesses, exits, or exit discharges be blocked?	YES	NO		Post signs identifying alternate exits for impacted personnel. Impacted personnel will follow procedures for ILSM evacuation and emergency response. Remaining means of egress shall be maintained at all times and inspected at least daily using the PCRA Inspection Checklist which will be kept in the project folder and at the work site.
4.	Will an exit access, exit, or exit discharge be obstructed?	YES	NO		Remaining means of egress shall be maintained at all times and inspected at least daily using the PCRA Inspection Checklist which will be kept in the onsite project folder. Considerations should include patient and support equipment movement
5.	Will fire alarm and detection systems be impaired in an unoccupied room?	YES	NO		Temporary fire alarm/detection systems shall be provided in the affected space and must be approved by the Director of Facilities or designee. Temporary systems will be tested and inspected monthly. Affected/nearby staff will be trained to recognize and respond to an alarm from the temporary fire system. Documentation kept with the onsite project folder.)
6.	Will hot work be required?	YES	NO		The Director of Facilities or designee will provide an additional portable fire extinguisher that will be kept in the construction area. Construction personnel will be provided training on the fire extinguishing equipment. Complete hot work permit. Initiate fire watch. Document according to fire watch procedure.
7.	Will the work area contain or be used to store excessive flammable material?	YES	NO		The Director of Facilities or designee will provide an additional portable fire extinguisher that will be kept in the area. Affected personnel will be provided training on the fire extinguishing equipment.
8.	Will the existing smoke compartment boundary, corridor construction, or other fire barriers be impaired/ degraded and the duration of the project be less than or equal to 5 calendar days?	YES	NO		**Business** Occupancy:
		YES	NO		**Ambulatory** Occupancy:
		YES	NO		**Other** Occupancy:

Instructions: PM to ensure the below answers are provided for each ILSM. For any "YES" answers, indicate the duration of the measure and review the, the "Implemented ILSM" column details the minimum required ILSM. Unless otherwise noted, the PM is responsible to implement all required ILSMs. Blank rows are provided to allow additional ILSMs as required for the safety of patients and staff and the preservation of the facility. ***Include drawings to show the affected area and where specific ILSMs will be implemented.*** PM to obtain proper review and approvals prior to beginning work.

Measure	ILSM Evaluation			Duration of ILSM dates/phase(s)	Implemented ILSM
9.	Will the existing smoke compartment boundary, corridor construction, or other fire barriers be impaired/degraded and the duration of the project be greater than 5 calendar days?	YES	NO		
10.	Will the existing ceiling or wall smoke barriers be impaired/degraded?	YES	NO		
11.	Will construction activity include excavations, hazardous storage areas, or site conditions that have potential to significantly impact life safety of patients or staff?	YES	NO		
12.	Will activity significantly increase the flammable and combustible fire loading in non-hazardous spaces?	YES	NO		
13.	Additional ILSM Considerations (as needed):	YES	NO		
14.	Additional ILSM Considerations (as needed):	YES	NO		

Additional Information or Requirements:	
Safety print name and signature:	**Facilities/ Projects Representative print name and signature:**
Date:	Date:

Instructions: Understanding that fire watch planning and implementation will require multiple steps, SCF Project Managers (PM) will coordinate at least 48 hours in advance when possible. A copy of the signed form(s) will be kept in the project file and made available upon request.

Signed and completed fire watch checklist must be routed to Safety (scfsafety@scf.cc) and the Facilities Project Manager.

Section 1: Fire Watch Requirements - Completed by SCF Project Manager – all fields required

Type of work (check all that apply):	☐ Hot Work ☐ Fire Alarm System Impairment ☐ Sprinkler System Impairment ☐ Smoke or Fire Barrier Impairment ☐ OTHER (explain):		
Building/ floor/ department/ room:			
Describe specific location and expected fire watch coverage:	-		
Project Manager Name with phone #, and email:	**Name:**	**Phone #:**	**Email:**
Expected Dates for planning and scheduling (estimated start and end date):	**Date From:**	**Date To:**	**Frequency/ interval (30 min, 60 min, 120 min):**

Section 2: Fire Watch Project Information

1.	Project Manager will provide ILSM and fire watch checklist as handoff to SCF Security.	Direct all questions to Project Manager
2.	SCF Security will: - Review ILSM, fire watch requirements, and documents. - Complete fire watch duties according to the frequency required and until notified work is complete. - Document fire watch checks on the attached log and submit to SCF Safety. - Know location of nearest fire extinguisher and alarm pull station in the fire watch area. - Activate Code Red emergency procedures immediately if smoke or fire is suspected or confirmed.	Direct all questions to Supervisor, Project Manager, and/or Facilities Manager.

Printed Name and Signature of Project Manager (or designee):

Date:

Forward signed copy to: SCF Safety (scfsafety@scf.cc)

Floorplan and additional information as needed:

Instructions: PM to ensure the below answers are provided for each utility system. For any "YES" answers, indicate the duration of the measure and review the "Implemented IUSM" column details for the minimum requirements. Unless otherwise noted, the PM is responsible to implement all required IUSMs. Blank rows are provided to allow additional IUSMs as required for the safety of patients and staff and the preservation of the facility. PM to obtain proper review and approvals prior to beginning work.

Interim Utility System Measures (IUSM)

All permits, risk assessments, mitigating measures and procedures shall be in place before work begins.

Measure	IUSM Evaluation			Duration of IUSM dates/phase(s)	Implemented IUSM
1.	Domestic Water	YES	NO		Complete **ICRA** & **ILSM**. Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
2.	Electrical	YES	NO		Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
3.	Emergency Power	YES	NO		Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
4.	Fire Detection	YES	NO		Complete **ILSM** and evaluate for Fire Watch Contact information for person performing work:
5.	Fire Suppression	YES	NO		Complete **ILSM** and evaluate for Fire Watch Contact information for person performing work:
6.	HVAC	YES	NO		Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
7.	Medical Gas	YES	NO		Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
8.	Pneumatic Tube	YES	NO		Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
9.	Suction	YES	NO		Follow Lock Out Tag Out procedures. Review and prepare emergency response plan specific to the work taking place. Coordinate with impacted department(s). Contact information for person performing work:
10	Other (explain):	YES	NO		Explain: Contact information for person performing work:

Completed by:		Date:	

Forward IUSM copy to: Safety (scfsafety@scf.cc)

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY OF REFERENCE STANDARDS

A. Regulatory requirements applicable to this project are the following:

B. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.

C. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

D. 29 CFR 1910 - Occupational Safety and Health Standards Current Edition.

E. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments, Supplements, and codes referenced herein.

F. NFPA 99 – Health Care Code

G. FGI Guidelines – 2022 Facility Guidelines Institute for Design and Construction.

H. IFC – International Fire Code – Current guidelines adopted by the State of Alaska.

I. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 005213 – Agreement Form.

C. Section 014000 - Quality Requirements.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 42 00
REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.
B. Section 005213 – Agreement Form.
C. Construction Drawings, Technical Specifications, Architect's Supplemental Instructions, Requests for Information, and Addenda.

1.02 SECTION INCLUDES

A. Use of references in Drawings and Specifications, including requirements for copies of reference standards at Project site.
B. Definitions and terms used in Specifications and Drawings, including abbreviations, acronyms, names, and terms which may be used in Specifications.

1.03 DEFINITIONS

A. "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.

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

C. "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."

D. "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.

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

F. "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.

G. “Provide”: Furnish and install, complete and ready for the intended use.

H. “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.

1.04 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. Comply with standard dates referenced in the International Building Code (IBC).

C. Copies of Standards: Each entity engaged in construction on Project shall 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 and make them available on request.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the specification section.

1.05 USE OF REFERENCES

A. References: The Drawings and Specifications contain references to various standards, standard specifications, codes, practices and requirements for products, execution, tests and inspections. These reference standards are published and issued by the agencies, associations, organizations and societies listed in this Section or identified in individual product specification Sections.

   1. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean the term used for Southcentral Foundation for purposes of the Contract.

2. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect or other responsible design professional for purposes of the Contract.

3. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications.

B. Relationship to Drawings and Specifications: Such references are incorporated into and made a part of the Drawings and Specifications to the extent applicable.

C. Referenced Grades Classes and Types: Where an alternative or optional grade, class or type of product or execution is included in a reference but is not identified on the Drawings or in the Specifications, provide the highest, best, and greatest of the alternatives or options for the intended use and prevailing conditions.

D. Copies of Reference Standards:

1. Reference standards are not furnished with the Drawings and Specifications because it is presumed that the Contractor, subcontractors, manufacturers, suppliers, trades, and crafts are familiar with these generally recognized standards of the construction industry.

2. Copies of reference standards may be obtained from publishing sources.

E. Jobsite Copies:

1. Contractor shall obtain and maintain at the Project site physical and/or digital copies of reference standards identified on the Drawings and in the Specifications in order to properly execute the Work.

2. At a minimum, the following shall be readily available, as applicable to the Work:
   a. State Building Codes: As referenced in Section 01 41 00 - Regulatory Requirements.
   b. Safety Codes: Occupational Safety and Health Act (OSHA) regulations and local and state Safety requirements and regulations.
   c. General Standards:
      1) Underwriters Laboratories, Inc. (UL) Building Products Listing.
      2) Factory Mutual Research Organization (FM) Approval Guide.
      3) American Society for Testing and Materials (ASTM) Standards in Building Codes.
      4) American National Standards Institute (ANSI) standards.
   d. Fire and Life Safety Standards: All referenced standards pertaining to fire rated construction and exiting.
   e. Common Materials Standards: American Concrete Institute (ACI), American Institute of Steel Construction (AISC), American Welding Society

(AWS), Gypsum Association (GA), National Fire Protection Association (NFPA), and Tile Council of America (TCA) standards to the extent referenced within the Contract Specifications.

f. Product Listings: Approval documentation, indicating approval of authorities having jurisdiction for use of product within the applicable jurisdiction.

F. Edition Date of References:

1. When an edition or effective date of a reference is not given, it shall be understood to be the current edition enforced by the Authorities Having Jurisdiction as of the date of the Agreement, Contract Drawings and Contract Specifications.

2. All amendments, changes, errata, and supplements as of the effective date shall be included.

G. ASTM and ANSI References: Specifications and Standards of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) are identified in the Drawings and Specifications by abbreviation and number only and may not be further identified by title, date, revision, or amendment. It is presumed that the Contractor is familiar with and has access to these nationally- and industry-recognized specifications and standards.

1.06 DEFINITIONS OF TERMS

A. Basic Contract Definitions: Words and terms governing the Work are defined in the Contract General and Supplementary Conditions, as referenced in the Agreement.

B. Words and Terms Used on Drawings and in Specifications: Additional words and terms may be used in the Drawings and Specifications and are defined as follows:

1. "Applicable:" As appropriate for the particular condition, circumstance or situation.

2. "Approve(d):" Approval action shall be limited to the duties and responsibilities of the party giving approval, as stated in the Conditions of the Contract. Approvals shall be valid only if obtained in writing and shall not apply to matters regarding the means, methods, techniques, sequences and procedures of construction. Approval shall not relieve the Contractor from responsibility to fulfill Contract requirements.

3. "And/or:" If used, shall mean that either or both of the items so joined are required.

4. "Directed:" Limited to duties and responsibilities of the Southcentral Foundation's Representative or Architect as stated in the Contract General Conditions, meaning "as instructed by SCF's Representative or Architect, in

writing, regarding matters other than the means, methods, techniques, sequences and procedures of construction. Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by SCF's Representative or Architect", "requested by the SCF's Representative or Architect", and similar phrases. No implied meaning shall be interpreted to extend the responsibility of the SCF's Representative, Architect or other responsible design professional into the Contractor's supervision of construction.

5. "Equal" or "Equivalent:" As determined by Architect or other responsible design professional as being equivalent, considering such attributes as durability, finish, function, suitability, quality, utility, performance, and aesthetic features.

6. "Furnish:" Means "supply and deliver, to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

7. "Indicated:" The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown", "noted", "scheduled", and "specified" are used to help the reader locate the reference. There is no limitation on location.

8. "Install:" Describes operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

9. "Installer:"
   a. "Installer" refers to the Contractor or an entity engaged by the Contractor, such as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
   b. "Experienced Installer:" The term "experienced," when used with "installer" means having a minimum of 5 previous Projects similar in size to this Project, knowing the precautions necessary to perform the Work, and being familiar with requirements of authorities having jurisdiction over the Work.

10. "Jobsite:" Same as site, Area of Work, or other similar term referencing the physical property where the work is to be carried out upon.

11. "Necessary:" With due considerations of the conditions of the Project and as determined in the professional judgment of the Architect or other responsible design professional as being necessary for performance of the Work in conformance with the requirements of the Contract Documents, but excluding matters regarding the means, methods, techniques, sequences, and procedures of construction.

12. "Noted:" Same as "Indicated."

13. "Per:" Same as "in accordance with," "according to" or "in compliance with."

14. "Products:" Material, system or equipment.

15. "Project Site:" Same as "Site." See definition of “Jobsite” above.

16. "Proper:" As determined by the Architect or other responsible design professional as being proper for the Work, excluding matters regarding the means, methods, techniques, sequences, and procedures of construction, which are solely the Contractor's responsibility to determine.

17. "Provide:" Means "furnish and install, complete and ready for the intended use."

18. "Regulation:" Includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as and rules, conventions and agreements within the construction industry that control performance of the Work.

19. "Required:" Necessary for performance of the Work in conformance with the requirements of the Contract Documents, excluding matters regarding the means, methods, techniques, sequences and procedures of construction, such as:
    a. Regulatory requirements of authorities having jurisdiction.
    b. Requirements of referenced standards.
    c. Requirements generally recognized as accepted construction practices of the locale.
    d. Notes, schedules and graphic representations on the Drawings.
    e. Requirements specified or referenced in the Specifications.
    f. Duties and responsibilities stated in the Bidding and Contract Requirements.

20. "Scheduled:" Same as "Indicated."

21. "Selected:" As selected by SCF’s Representative, Architect or other responsible design professional from the full selection of the manufacturer's products, unless specifically limited in the Contract Documents to a particular quality, color, texture or price range.

22. "Shown:" Same as "Indicated."

23. "Site:" Same as "Site of the Work" or "Project Site;" the area or areas or spaces occupied by the Project and including adjacent areas and other related areas occupied or used by the Contractor for construction activities, either exclusively

or with others performing other construction on the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.

24. "Supply:" See "Furnish."

25. "Testing Laboratory" or "Testing Laboratories:" An independent entity engaged to perform specific inspections or tests, at the Project Site or elsewhere, and to report on, and, if required, to interpret, results of those inspections or tests. Refer to Section 014000 – Quality Requirements.

26. "Testing and Inspection Agency:" Same as "Testing Laboratory."

1.07 ABBREVIATIONS, ACRONYMS, NAMES AND TERMS, GENERAL

A. Abbreviations, Acronyms, Names and Terms: Where acronyms, abbreviations, names, and terms are used in the Drawings, Specifications, or other Contract Documents, they shall mean the recognized name of the trade association, standards generating organization, authority having jurisdiction or other entity applicable.

B. Abbreviations, General: The following are commonly used abbreviations which may be found on the Drawings or in the Specifications. Refer to the Drawings for additional abbreviations or acronyms. This is a partial list. If there is any discrepancy or confusion, notify Southcentral Foundation in writing by RFI:

AC or ac	Alternating current (or air conditioning, depending on context)
AMP or amp	Ampere
C	Celsius
CFM or cfm	Cubic feet per minute
CM or cm	Centimeter
CY or cy	Cubic Yard
DC or dc	Direct Current
DEG or deg	Degrees
F	Fahrenheit
FPM or fpm	Feet per minute
FPS or fps	Feet per second
FT or ft	Foot or feet
Gal or gal	Gallons
GPM or gmp	Gallons per minute
IN or in	Inches
Kip or kip	Thousand Pounds
KSI or ksi	Thousand pounds per square inch
KSF or ksf	Thousand pounds per square foot
KV or kv	Kilovolt

KVA or kva	Kilovolt amperes
KWH or kwh	Kilowatt hour
LBF or lbf	Pounds force
LF or lf	Lineal foot
M or m	Meter
MPH or mph	Miles per hour
MM or mm	Millimeter
PCF or pcf	Pounds per cubic foot
PSF or psf	Pounds per square foot
PSI or psi	Pounds per square inch
PSY or psy	Pounds per square yard
SF or sf	Square foot
Sy or sy	Square yard
V or v	Volts

C. Abbreviations and Acronyms for 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 Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

D. Undefined Abbreviations, Acronyms, Names and Terms: Words and terms not otherwise specifically defined in this Section, in the Instructions to Bidders, in the Contract General Conditions, on the Drawings or elsewhere in the Specifications, shall be as customarily defined by trade or industry practice, by reference standard and by specialty dictionaries such as the following:

1. Dictionary of Architecture and Construction, Fourth Edition (Cyril M. Harris, McGraw-Hill Book Company, 2005).

2. Encyclopedia of Associations, published by Gale Research Co., commonly available in public libraries.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 01 Specifications apply to this section.

B. Document 00 52 13 – Agreement Form.

1.02 SUBMITTALS

A. Submit schedule of proposed connection and termination dates 15 days before implementation.

B. Submit site plan showing temporary facilities, utility connections, and construction personnel parking areas.

1.03 QUALITY ASSURANCE

A. Arrange and pay for Authorities Having Jurisdiction to approve each temporary utility before use. Obtain necessary certifications and permits.

1.04 PROJECT CONDITIONS

A. Assume responsibility for operation, maintenance, and protection.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

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

2.02 TEMPORARY ELECTRICITY

A. If required, Contractor shall provide and shall pay for power service required from utility source.

B. Provide power outlets for construction operations, with branch wiring and distribution boxes. Provide flexible power cords as required.

C. Provide main service disconnect and overcurrent protection at convenient location.

2.03 TEMPORARY LIGHTING

A. Provide and maintain lighting for constructions operations.

B. Permanent building lighting may be utilized during construction only with written pre-approval from Owner.

2.04 TEMPORARY HEAT

A. Provide and pay for heat devices and heat as required to maintain specified conditions for construction operations. Use equipment that will not have harmful effect on completed installation.

1. Use permanent heating system, or provide vented, self-contained, liquid-gas, propane-gas, or fuel-oil heaters with individual space thermostatic control.
2. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
3. 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. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

B. Maintain minimum ambient temperature of 50 degrees F. in areas where construction is in progress, unless indicated otherwise in Specifications.

2.05 HUMIDITY CONTROL

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

2.06 TELEPHONE SERVICE

A. Provide, maintain, and pay for mobile telephone service to field supervisor(s) at time of project mobilization through project completion.

2.07 COMPUTER AND COPY SERVICE

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

B. Provide, maintain, and pay for 8-1/2 x 11-inch copy machine in field office.

2.08 TEMPORARY WATER SERVICE

A. Existing water service may be used. Owner will pay cost of water used. Exercise measures to conserve water.

B. If Owner provided water is not available or adequate, provide, maintain, and pay for suitable quality water required for construction.

1. Extend branch piping with outlets located so water is available by hoses with threaded connections.

2. Sterilize temporary water piping prior to use.

2.09 TEMPORARY SANITARY FACILITIES

A. Provide and maintain self-contained facilities and enclosures including toilets, wash facilities and drinking water, for use of construction persons.

2.10 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect adjacent properties from damage from construction operations. Coordinate all requirements for infection control with the Owner.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

2.11 FIELD OFFICES AND SHEDS

A. Office: Suitable for Contractor field management and tool storage, weather-tight, with lighting, electrical outlets, heating equipment and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for project meetings, with table and chairs necessary to accommodate all attendees.

C. Locate offices and sheds a minimum distance of 20 feet from existing structures unless Owner approves in writing.

D. Provide fire resistant rated walls where closer than 30 feet to other permanent buildings or interior property lines. Not required at public right of way.

PART 3 - EXECUTION

3.01 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.

3.02 WEATHER CONTROL

A. Provide temporary insulated weather-tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specifications Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

3.03 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual Specifications Sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

C. Provide protection covering at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

3.04 SECURITY

A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft.

B. Coordinate with Owner’s security program.

3.05 PARKING

A. Coordinate with Owner to arrange for parking areas to accommodate construction personnel.

B. When site space is not adequate, provide additional off-site parking.

C. Designate one parking space onsite for the Owner.

3.06 PROGRESS CLEANING

A. Maintain work and storage area free of waste materials, debris, and rubbish. Maintain site in a clean and orderly conditions to maintain site passage and exits, and to avoid fire hazard.

B. Provide waste-collection containers in sizes adequate to handle construction waste.

C. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the spaces.

D. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

E. Remove waste materials, debris, and rubbish from site periodically at least once weekly and dispose off-site.

F. Open free-fall chutes not permitted. Terminate closed chutes into appropriate containers with lids.

3.07 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion Inspection.

B. Remove underground installations to a minimum depth of two feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 01 40 00 - Quality Requirements

C. Section 01 70 00 – Execution and Closeout Requirements

1.02 DEFINITIONS

A. Products: New material, machinery, components, equipment, fixtures, and systems forming the Work. Products do not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.

B. Products may also include existing materials or components required for reuse where specified.
   1. Provide interchangeable components of the same manufacturer, for similar use products.

C. Substitutions: Changes in products from those required by the Contract documents, proposed by the Contractor.
   1. Substitutions will not be accepted during Bidding.

1.04 PRODUCT SUBMITTALS

A. Product List: Submit a list, showing proposed products.
   Include manufacturer's name and proprietary product names for each product.
   1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. Form: Tabulate information for each product under the following column heading:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.

g. Projected delivery date or time span of delivery period.
h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after notice to proceed, submit initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
   a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
4. Completed List: Within 60 calendar days after notice to proceed to construction, submit product list. Include a written explanation for any omissions of data and for variations from Contract requirements.
5. Architect's Action: Architect will respond in writing to Contractor within 7 calendar days, excluding SCF recognized holidays, of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit one request for each proposed substitution. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for substitutions.
2. Show history of product in Alaska.

C. Comparable Product Requests: Submit for 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.

D. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt.

1.05 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.

1.06 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. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   6. Protect stored products from damage and freezing.

1.07 PRODUCT WARRANTIES

A. 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.

PART 2 – PRODUCTS

2.01 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. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
3. Where products are accompanied by the term “as selected,” Architect will make selection.
4. Where products are accompanied by the term “match,” sample to be matched is Architect’s or existing construction.
5. Descriptive, performance, and reference standard requirements in the Specifications establish “salient characteristics” of products.
6. Or Equal: Where products are specified by name and accompanied by the term “or equal” or “or approved,” comply with product specification.

B. Product Selection Procedures:
1. 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.
2. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or with an unnamed manufacturer, that complies with requirements.
3. 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 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.

2.02 PRODUCT SUBSTITUTIONS

A. See Specification Section 01 25 00 – Substitution Procedures.

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Cutting and patching.
C. Surveying for laying out the work.
D. Cleaning and protection.
E. Starting of systems and equipment.
F. Demonstration and instruction of Owner personnel.
G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
H. General requirements for maintenance service.
I. Project record documents.
J. Operation and maintenance data.
K. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Drawings and General Provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.
B. Section 005213 – Agreement Form
C. Section 011000 – Summary of Work: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
D. Section 012000 – Price and Payment Procedures.
E. Section 013000 - Administrative Requirements: Submittals procedures.
F. Section 014000 - Quality Requirements: Testing and inspection procedures.
G. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.
H. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.
I. Section 017419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
J. Section 017610 - Temporary Protective Coverings: Materials for protection of installed work.

K. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned where indicated in specific specification sections.

L. Section 018100 – Commissioning.

M. Section 078400 - Firestopping.

N. Individual Product Sections: Specific requirements for operation and maintenance data.

O. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Effect on work of Owner or separate Contractor.
      f. Written permission of affected separate Contractor.
      g. Date and time work will be executed.

D. Project Record Documents: Submit electronic documents to Architect with claim for final Application for Payment.

E. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed electronic documents within 10 calendar days, excluding SCF recognized holidays, after acceptance.
   2. Submit one electronic copy of completed documents 15 calendar days, excluding SCF recognized holidays, prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect

comments. Revise content of all document sets as required prior to final submission.

3. Submit 1 hard copy and 1 electronic set of revised final documents in final form within 10 calendar days, excluding SCF recognized holidays, after final inspection.

F. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit electronic documents within 10 calendar days, excluding SCF recognized holidays, after acceptance.
   2. Make other submittals within 10 calendar days, excluding SCF recognized holidays, after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 calendar days, excluding SCF recognized holidays, after acceptance, listing the date of acceptance as the beginning of the warranty period.
   4. Submit 1 final hard copy and 1 electronic copy of all warranties and bonds for entire project, prior to final Application for Payment.

1.04 QUALIFICATIONS

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

1.05 PROJECT CONDITIONS

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

B. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

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

1.06 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of

interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.07 CLOSEOUT PROCEDURES

A. Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion and including the following:
   1. Certificate of Substantial Completion: AIA Form G704-2017 or owner approved shall be used.
   2. Contractors Affidavit of Payment of Debts and Claims: AIA Form G706-1994 or owner approved shall be used.
   3. Contractors Affidavit or Release of Liens: AIA Form G706A-1994 or owner approved shall be used.
   4. Consent of Surety Company to Final Payment: AIA Form G707-1994 shall be used.

B. OWNER may occupy portions of the project for its use, under provisions to be stated in Certificate of Substantial Completion.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.08 SUBSTANTIAL COMPLETION

A. 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, boiler operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, 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 to Owner. Advise Owner's personnel of changeover.
   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.

B. Inspection: Submit a written request for inspection for Substantial Completion to Architect or Owner's Representative. On receipt of request, Architect or Owner's Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect or Owner's Representative 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 and/or Owner's Representative, 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.

1.09 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 Section 01 20 00 – Price and Payment Procedures.
   2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or otherwise resolved for acceptance.
   3. Submit evidence of insurance coverage through warranty period.
   4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

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 notify Contractor of construction that must be completed or corrected before certificate will be issued. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Preparation and Submit 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.

1.10 WARRANTIES

A. Submittal Time: Submit electronic and 1 hard copy of warranties on request of Architect or Owner's Representative for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 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.

C. Organize hard copy of warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8 ½ by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.

3. Identify each binder on the front and spine with the typed or printed title “Warranties,” Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

E. In addition to the hard copy, also provide one PDF electronic copy of warranty manual. Electronic copy shall be tabbed using digital bookmarks.

1.11 REINSPECTION FEES

A. Should status of completion of Work require reinspection by Contracting Officer due to failure of Work to comply with Contractor’s claims on initial inspection, Owner will deduct the amount of costs for reinspection services from final payment to the Contractor.

1.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.13 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following Record Documents; record actual revisions to the Work differing from Contract Drawings. Documents shall be electronic and shall be accessible at all times to Architect, Owner, and Owner’s Representative:

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

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Record Specifications: Clearly identify and record at each product section description of actual products installed, particularly concealed products, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and Modifications.

E. Contract Drawings and Shop Drawings: Clearly mark each item to record actual construction graphically to scale including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract Drawings.

F. Final Documentation after completion of work.
   1. Final drawing annotations shall be noted on a clean electronic copy of the drawings titled Contract As-Built Drawings.
   2. Record document annotations to electronic copies of Contract As-Built Specifications.
   3. Annotations shall be typewritten with minimum 10-point font lettering of quality equal to original documents.

G. Before final Application for Payment, submit contractor record annotations on Contract Documents to Architect with dated transmittal letter containing project title, list of documents and signature of Contractor certifying that all concealed changes have been recorded before final Application for Payment.

1.14 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual Specification Sections.
B. Deliver to project site and place in location as directed, obtain receipt prior to final payment.

PART 2 – PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

2.02 CLEANING MATERIALS

A. 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

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or mis-fabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
F. Utilize recognized engineering survey practices.
G. Establish elevations, lines, and levels. Locate and lay out by instrumentation and similar appropriate means:
H. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
I. Grid or axis for structures.
J. Building foundation, column locations, and ground floor elevations.
K. Periodically verify layouts by same means.
L. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 CUTTING AND PATCHING

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

B. Perform whatever cutting and patching is necessary to:

1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.

5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

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

D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

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

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

G. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.

I. Patching:

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

3.06 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

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

3.08 SYSTEM STARTUP

A. Coordinate with requirements of Section 018100 - Commissioning.
B. Coordinate schedule for start-up of various equipment and systems.
C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
E. Verify that wiring and support components for equipment are complete and tested.
F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

A. See Section 017900 - Demonstration and Training.

3.10 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
B. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
C. Use cleaning materials that are nonhazardous.

D. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

E. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment or other surfaces and equipment.

F. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

G. Clean filters of operating equipment.

H. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, etc.

I. Clean site: sweep paved areas, remove petrochemical spills, rake clean landscaped surfaces, remove all nails and screws using a magnetic sweeper.

J. Remove waste, surplus materials, trash/rubbish, and construction facilities, materials, and equipment from the site; dispose of in legal manner; do not burn or bury.

K. 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.

L. 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.

M. 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.

N. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

O. Sweep concrete floors broom clean in unoccupied spaces.

P. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

Q. Touch up and otherwise repair and restore exposed finishes and surfaces damaged by this work. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

R. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

S. Replace parts subjected to construction operating conditions.

T. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

U. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

V. Clean ducts, blowers, and coils if units were operated without filters during construction.

W. 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.

X. Leave Project clean and ready for occupancy.

3.12 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Provide electronic copies to Architect and Owner, unless otherwise specified.

C. Accompany Architect, Owner, or Owner's Representative on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

D. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

E. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

I. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.13 PROJECT RECORD DOCUMENTS

A. Maintain on site one electronic set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.

4. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Clearly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings: Clearly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.14 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.15 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Additional information as specified in individual product specification sections.

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

3.16 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

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

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

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

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

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

F. Include manufacturer’s printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

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

I. Provide control diagrams by controls manufacturer as installed.

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

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

3.17 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into a single set of durable manuals for Owner's personnel use (1 copy), with data arranged in the same sequence as, and identified by, the specification sections. An identical electronic copy, electronically bookmarked, shall also be submitted.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system (separate bookmark for each system in electronic copy).

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring

size. When multiple binders are used, correlate data into related consistent groupings.

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

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

F. Tables of Contents: List every item separated by a divider (or electronic bookmarks), using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system (and bookmarks in electronic copy); identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20-pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.

   Operation and Maintenance Data: Arranged by system, then by product category, Source data, Operation and maintenance data, Field quality control data, and Photocopies of warranties and bonds.

3.18 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 calendar days, excluding SCF recognized holidays, after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance hard copy manuals, indexed separately on Table of Contents. Include electronic copies of each, electronically tabbed, in the electronic copy of operation and maintenance manual.

F. Include 1 separate hard copy manual and 1 electronic manual of all warranties and bonds (submitted separately from operation and maintenance manual).

3.19 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

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

END OF SECTION

SECTION 01 78 24
FACILITY ASSET DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Populate Facility Asset Data fields in Excel template.

B. SCF uses Gordian Cloud Platform (GCP) and Brightly Asset Essentials CMMS to log and track assets:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Items specified in individual product Sections.
   6. Conveying systems.
   7. Lab equipment.
   8. Roofing systems and roofing specialties.
   9. Integrated Automation Controls – equipment, valves, dampers.
   10. Fire suppression – valves, equipment, pumps.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 017000 - Closeout Submittals: Operation and maintenance manuals.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures; except:
   1. Make Facility Asset Data submittals on time schedule specified by SCF.
   2. Progress submittal will be at 95% design or GMP negotiations.
   3. Prefinal submittal will be when as-builts are complete.
   4. Final submittal will be at Closeout matched with Record Documents.

B. Facility Asset Data Excel File
   1. x

1.04 QUALITY ASSURANCE

1. Contractor provides a Facility Asset Data Excel File preparer familiar with the design, construction and maintenance of the assets.

DRAFT

2. Where a single preparer is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.01 FIELD VERIFICATION

A. Field verify Facility Asset Data information at prefinal submittal and final submittal with Contractor and SCF personnel. Include in the meeting Contractor Facility Asset Data Excel File preparer, Contractor Quality Control Manager, Commissioning Authority, SCF CPM, and SCF Manager of Facilities.

B. X fields will be verified. If mistakes found or incomplete, corrections will be made within 14 days.

3.02 TRAINING - GENERAL

A. x

END OF SECTION

DRAFT

Brightly Inventory/Asset List
[for completion post-commissioning]

Name

SiteNo

SiteName

ParentAssetAssetNo

ParentAssetName

CostCenterNo

CostCenterName

CategoryNo

CategoryName

CategoryPath

LocationNo

LocationName

LocationPath

SupplierName

SupplierNo

AssetConditionName

AssetStatusName

CriticalityName

AssetNo

SerialNo

Make

Model

BarCode

RFID

PurchasePrice

PurchaseDate

Brightly Inventory/Asset List
[for completion post-commissioning]

PurchaseInvoiceNo

LifeTime

ReplacementCost

SalvageValue

IsToolCrib

LastCheckedOutDate

CheckedOutByUserNo

CheckedOutByUserFirstName

CheckedOutByUserLastName

PhotoName

PhotoType

PhotoUrl

PlatformLayerId

Note

ToolCribNote

PurchaseNote

WarrantyNote

EmergencyNote

SafetyNote

TrainingNote

ShutdownProcedure

LOTOProcedure

ConditionDate

EstimatedReplacementDate

AssessmentNote

WarrantyTitle

Brightly Inventory/Asset List
[for completion post-commissioning]

WarrantyExpirationDate

WarrantyVendorName

WarrantyVendorNo

MediumName

MediumType

MediumUrl

AssetContactName

AssetContactCompany

AssetContactPhone1

AssetContactPhone2

AssetContactFax

AssetContactEmail

AssetContactUrl

AssetUserNo

AssetUserFirstName

AssetUserLastName

AssetPartPartNo

AssetPartBarcode

AssetPartName

SafetyProgramNo

SafetyProgramName

IsRequired

MeterTitleNo

MeterTitleName

MeterTypeNo

MeterTypeName

MeterTitleThresholdMin

MeterTitleThresholdMax

MeterTitleIsAverageEnabled

MeterTitleIsTotalEnabled

MeterTitleDescription

MeterTitleDisplayFormat

CrewName

ManufactureOn

ManufacturerId

ManufacturerNo

ManufacturerName

Description

OutOfServiceBeginDate

OutOfServiceEndDate

PlacedOn

RemovedOn

TagNumber

Latitude

Longitude

IsSystem

MeasurementUnitId

MeasurementUnitName

MeasurementUnitNo

UOMQuantity

UOMCost

RegionalIndex

Brightly Inventory/Asset List
[for completion post-commissioning]

CF_Drawing No:

CF_VIN

CF_Vehicle Style

CF_Vehicle Class

CF_Vehicle Color

CF_License Type

CF_License No

CF_License ExpDate

CF_Engine Type

CF_Transmission Type

CF_Axles

CF_Licensed Weight

CF_Empty Weight

CF_Cargo Weight

CF_Gross Weight

CF_Primary Driver

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

E. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered

form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

PART 2 - PRODUCTS – NOT USED

PART 3 – EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

END OF SECTION

SECTION 01 76 10
TEMPORARY PROTECTIVE COVERINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Temporary protective coverings for installed floors, walls, and other surfaces.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 005213 – Agreement Form.

C. Section 017000 - Execution and Closeout Requirements: Coordination of requirements for materials specified in this section.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard 2012 (Reaffirmed 2020).

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide materials that are easily removed without damage to the surfaces covered and with the following characteristics:
   1. Impact resistant.
   2. Slip resistant.
   3. Flame retardant.

PART 3 – EXECUTION

3.01 PREPARATION

A. Remove dirt and debris from surfaces to be protected.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Trim or overlap sheet materials to fit area to be covered.

C. Roll out and cut rolled materials to fit area to be covered.

D. Tape seams. Avoid taping directly to finished surfaces.
E. Stretch self-adhering film materials to completely cover surface.
F. Install door jamb protection to full height of opening.

3.03 REMOVAL

A. Remove protective coverings prior to Date of Substantial Completion. Reuse or recycle materials if possible.

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 – GENERAL

1.01 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Items specified in individual product Sections.
   6. Conveying systems.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.

B. Section 017000 - Closeout Submittals: Operation and maintenance manuals.

C. Section 018100 - Commissioning: Additional requirements applicable to demonstration and training.

D. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and indicated elsewhere for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Commissioning Authority for review and inclusion in overall training plan.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such as slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide 1 hard copy training manual for each attendee; allow for minimum of two attendees per training session. Provide an electronic copy of training manuals 48 hours in advance of training.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data (hard copy/physical manual and electronic manual).

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

E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: MP4
   2. Label each video with session identification and date.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

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

3.02 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two-hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule

has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

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

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

END OF SECTION

SECTION 01 91 00
COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Commissioning Description.
   2. Submittals.
   3. Commissioning Services.
   4. Commissioning Responsibilities.
   5. Commissioning Meetings.
   6. Commissioning Reports.
   7. Test Equipment.
   8. Pre-Functional Verification Check and Startup Procedures.
   9. Functional Performance Test Procedures.
   10. Function Performance Test Methods.
   11. Deficiencies and Test Approvals.

B. Related Sections:
   1. Section 00 52 13 – Agreement Form
   2. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 00 & 01 Specifications apply to this section.
   3. Section 23 08 00 - Commissioning of HVAC.
   4. Section 26 08 00 - Electrical Systems Commissioning.

1.02 REFERENCES

A. Associated Air Balance Council:
   1. AABC - AABC Commissioning Guideline.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE Guideline 1.1 - The HVAC Commissioning Process.

C. National Environmental Balancing Bureau:
   1. NEBB - Procedural Standards for Building Systems Commissioning.

1.03 COMMISSIONING DESCRIPTION

A. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and Contracting Officer's operational needs. Commissioning process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and verification of actual performance.

B. Commissioning Intent:

1. Verify equipment and systems are installed in accordance with manufacturer's instructions, industry accepted minimum standards, and Contract Documents.
2. Verify equipment and systems receive adequate operational checkout by Contractor.
3. Verify and document proper performance of equipment and systems.
4. Verify complete operation and maintenance documentation is delivered to Contracting Officer.

C. Equipment and Systems to be Commissioned:
   1. Refer to Section 23 08 00 for Mechanical Equipment and Systems.
   2. Refer to Section 26 08 00 for Electrical Equipment and Systems.

D. Commissioning does not relieve Contractor of responsibility to provide finished and fully functioning Project.

E. Commissioning Process Overview and General Order of Commissioning Tasks:
   1. Commissioning begins with initial commissioning meeting.
   2. Equipment documentation is submitted to Commissioning Authority during normal submittals along with detailed start-up procedures.
   3. The Contractor, equipment and system installers work together to develop the startup plan and the pre-functional verification checklists that are to be completed by the Contractor and installers, during the pre-functional verification check and startup process.
   4. Equipment and system installers execute and document pre-functional verification checklists and startup. The Contractor documents that the pre-functional checklists and startup were completed according to approved plans.
   5. In general, checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with pre-functional verification checklists being completed before functional testing.
   6. Commissioning Authority develops the specific equipment and system functional test procedures. The Contractor and equipment and system installers review procedures.
   7. The equipment and system installers execute functional performance testing procedures under direction of and documented by Commissioning Authority.
   8. Items of non-compliance in material, installation or setup are corrected at Contractor's expense and system retested.
   9. Commissioning Authority reviews operation and maintenance documentation for adherence to the contract documents.
   10. Commissioning is completed before Final Completion.

1.04 COMMISSIONING SUBMITTALS

A. Furnish one copy of the Contractor developed pre-functional verification checklists and startup plan to Commissioning Authority for review and approval within 6 months of contract award. Include the following as minimum:
   1. Manufacturer's standard startup procedures copied from installation manuals.
   2. Manufacturer's standard field checkout sheets.
   3. Supplemental procedures and checklists prepared by equipment and system installers to accommodate Project conditions.
   4. Include boxes or lines for recording and documenting checking and inspections of each procedure and summary statement with signature block.

B. Commissioning Authority will review submittals for conformance to the Contract Documents as related to commissioning process for the primary purpose of aiding development of functional testing procedures.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Closeout Procedures: Requirements for submittals.

B. Furnish one copy of the Contractor developed pre-functional verification checklists and startup plan to Commissioning Authority for review and approval prior to commissioning. Include the following as minimum:
   1. Manufacturer's standard startup procedures copied from installation manuals.
   2. Manufacturer's standard field checkout sheets.
   3. Supplemental procedures and checklists prepared by equipment and system installers to accommodate Project conditions.
   4. Include boxes or lines for recording and documenting checking and inspections of each procedure and summary statement with signature block.

C. Commissioning Authority will review submittals for conformance to the Contract Documents as related to commissioning process for the primary purpose of aiding development of functional testing procedures.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with ASHRAE Guideline 1.1.

1.07 COMMISSIONING RESPONSIBILITIES

A. Responsibilities indicated for Contracting Officer, Architect/Engineer, and Commissioning Authority are provided only to clarify commissioning process.

B. Architect/Engineer Responsibilities:
   1. Perform site observation of each system before system startup.
   2. Review the contractor developed commissioning schedule.

3. Clarify operation and control of commissioned equipment when specifications, control drawings, or equipment documentation are not sufficient for writing detailed functional performance testing procedures.
4. Coordinate resolution of design issues affecting system performance identified during commissioning.
5. Review and approve operation and maintenance manuals.
6. Review the Contractor developed pre-functional checklists for equipment or systems to be commissioned.
7. Review the Commissioning Authority developed functional test procedures for equipment or systems to be commissioned.

C. Commissioning Authority Responsibilities:
   1. Basic Responsibilities:
      a. Coordinate, direct, and approve commissioning work.
      b. Develop and coordinate execution of commissioning plan. Revise commissioning plan to suit Project conditions.
      c. Coordinate commissioning work with Contractor for inclusion in Project schedule.
      d. Plan and conduct commissioning meetings.
      e. Request and review commissioning submittals required to perform commissioning tasks.
      f. Review the Contractor developed start-up plan.
      g. Review the Contractor developed pre-functional checklists.
      h. Develop the functional performance test procedures.
      i. Review test and balance execution plan.
      j. Document equipment and systems are installed and perform in accordance with design intent and Contract Documents.
      k. Notify the Architect/Engineer of deficiencies.
      l. Coordinate resolution of deficiency corrections with the contractor.
      m. Review operation and maintenance manuals.
      n. Compile commissioning record and testing data manual.
      o. Provide final commissioning report.
   2. Commissioning Authority may not:
      a. Release, revoke, alter, or enlarge on requirements of Contract Documents.
      b. Approve or accept any portion of the Work.
      c. Assume duties of Contractor or Architect/Engineer.
      d. Stop the Work.

D. Contracting Officer Responsibilities:
   1. Arrange for Contracting Officer's personnel to attend commissioning activities and training sessions according to commissioning plan.
   2. Approve commissioning work completion.

E. Contractor Responsibilities:

1. Include requirements for commissioning submittal data, operation and maintenance data, commissioning tasks for equipment and systems indicated to be commissioned.
2. Facilitate coordination of commissioning work by Commissioning Authority.
3. Schedule and attend commissioning meetings.
4. Develop a commissioning schedule for completion of the commissioning work, coordinate schedule with commissioning authorities commissioning plan.
5. Develop equipment start-up and initial start-up plan.
6. Develop pre-functional verification checklists or each piece of equipment and system to be commissioned.
7. Review the Commissioning Authority developed functional performance test procedures.
8. Require equipment and system installers to review and provide comments on functional test procedures.
9. Cooperate with Commissioning Authority and provide access to the work.
10. Furnish qualified personnel to assist in completing commissioning.
11. Require manufacturers to review commissioning test procedures for equipment installed by manufacturer.
12. Furnish proprietary test equipment required by manufacturers to complete equipment and system tests.
13. Furnish manufacturer's qualified field representatives as specified in Section 014000 - Quality Requirements and individual specification sections to assist in completing commissioning.
14. Ensure equipment and system installers execute commissioning responsibilities according to Contract Documents and schedule.
15. Prepare operation and maintenance manuals specified in Section 017000 - Execution Requirements. Update original sequences of operation reflecting actual installation.

1.08 COMMISSIONING MEETINGS

A. Section 013100 – Project Management and Coordination.

B. Commissioning Authority will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Initial Commissioning Meeting:
   1. Contractor will schedule meeting within 90 days after Notice of Award.
   2. Attendance Required: Commissioning Authority, Architect/Engineer, Contractor, subcontractors, test, adjust and balance agency. Require attendance by installers of the following equipment and systems indicated to be commissioned including:
      a. Mechanical equipment and systems.
      b. Electrical equipment and systems.
      c. Temperature controls equipment and systems.
   3. Agenda:

a. Designation of personnel representing parties for commissioning activities.
b. Review commissioning process and responsibilities.
c. Review commissioning plan development procedures.
d. Review required commissioning submittals.
e. Review initial commissioning schedule.

D. Progress Commissioning Meetings:
1. Progress commissioning meetings will be scheduled as required by the commissioning team.

E. Contractor will record meeting minutes and distribute copies to participants and those affected by decisions made.

1.09 COMMISSIONING REPORTS

A. Commissioning Authority Reports:
1. Observation reports of specific commissioning activities.
2. Testing progress and approvals.
3. Deficiency and deficiency resolution reports.

B. Functional Performance Test Procedures Forms: Develop functional test procedure forms containing the following information:
1. Project information.
2. Participating parties.
3. Unique test identification number, and reference to unique verification checklist and startup documentation identification numbers for piece of equipment.
4. Equipment identification number.
5. System and or equipment name.
6. Copy of specific sequence of operations or other specified parameters being verified.
7. Required pre-test field measurements.
8. Special cautions, alarm limits, and safety concerns.
9. Specific step-by-step procedures to execute test, in clear, sequential, and repeatable format.
10. Acceptance criteria of proper performance with Yes / No check box to allow for marking whether or not proper performance of each part of test was achieved.
11. Section for comments.
12. Signatures and date block for Commissioning Authority.

1.10 SEQUENCING

A. Section 01 10 00 – Summary of Work: Requirements for sequencing.

B. Phase 1A and Phase 1B: Sequence work to complete pre-functional testing and test and balance of all new system installed in Phase 1A and Phase 1B prior to Phase 1A and Phase 1B substantial completion. Provide preliminary

O&M's for review prior to commissioning Phase 1A and Phase 1B. O&M's to include test and balance report for Phase 1A and Phase 1B.

C. Phase 2: Sequence work to complete pre-functional testing and test and balance of all systems prior to substantial completion of Phase 2. Complete tests of any equipment not completed at the end of Phase 1A and Phase 1B. Provide complete test and balance report for the entire facility, including all Phase 2, Phase 1A and Phase 1B systems.

D. Sequence work to achieve Functional Completion before Final Completion. Complete the following for each piece of equipment and system indicated to be commissioned to achieve Functional Completion:
   1. Complete and sign the pre-functional verification checklists.
   2. Submit final approved test and balance report.
   3. Complete functional performance testing.
   4. Correct identified deficiencies or obtain approval by Contracting Officer to exclude deficiencies from Functional Completion.
   5. Submit approved operation and maintenance data manuals.

1.11 SCHEDULING

A. Schedule work to allow adequate time for commissioning activities.

B. Identify commissioning milestones, activities, and durations on Project schedule.
   1. Identify the following on the schedule:
      a. Pre-functional verification check and startup.
      b. Functional performance testing.
      c. Operation and maintenance manual submittal.
      d. Functional testing.
      e. Commissioning completion.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.01 EXAMINATION

C. Verify equipment and systems are installed in accordance with individual specification sections.

D. Verify utility and power connections are complete and services operational.

3.02 PRE-FUNCTIONAL VERIFICATION CHECK AND STARTUP PROCEDURES

E. Verification Check and Startup:
   1. Perform pre-functional verification checklists in accordance with the contractor's startup plan.

2. Record completion of each procedure. Indicate results of procedure where required.
3. Identify items not completed successfully.
4. Sign and date completed pre-functional verification checklists.
5. Submit complete pre-functional verification checklist to Commissioning Authority.
6. Submit completed start-up plan to Commissioning Authority.

F. Deficiencies and Approvals:
1. Commissioning Authority will review the pre-functional verification checklist and issue deficiency report.
2. The Contractor shall correct deficiencies and resubmit the updated pre-functional verification checklist including a statement indicating corrections made.
3. Repeat process until all pre-functional verification checklists are complete.
4. Costs for incomplete verification check and startup items that later cause deficiencies or delays during functional tests may be charged to party responsible for incomplete item.

3.03 FUNCTIONAL PERFORMANCE TEST PROCEDURES

G. Complete the following before performing functional tests:
1. Pre-Functional verification check and startup.
2. Air and hydronic system balancing report.

H. Notify Commissioning Authority of completion of pre-functional verification check and startup activities.

I. Commissioning Authority will direct, witness, and document results of functional performance tests.

J. Conduct functional performance tests as specified in Section 23 08 00 and 26 80 00.

K. Demonstrate each piece of equipment and system is operating according to documented design intent and Contract Documents.
1. Conduct testing proceeding from components to subsystems, to systems.
2. Bring equipment and systems to condition capable full dynamic operation.
3. Verify performance of individual components and systems.
4. Verify performance of interactions between systems.
5. Identify and correct areas of deficient performance.

L. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, unoccupied, warm up, cool down, partial load and full load conditions.
1. Verify each sequence in sequences of operation.
2. Test for proper responses to power failure, freezing, overheating, low oil pressure, no flow, equipment failure, and other abnormal conditions.

3.04 FUNCTIONAL PERFORMANCE TEST METHODS

M. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by stand-alone data loggers as specified for each piece of equipment or system.
   1. Commissioning Authority may require alternate or additional method, other than specified method.
   2. Commissioning Authority will determine test method when method is not specified.

N. Simulated Conditions: Simulating conditions, not by overwritten values, is permitted. Timing tests to use real conditions is encouraged wherever practical.

O. Overwritten Values: Overwriting sensor values to simulate conditions may be used with caution and avoided when possible.

P. Simulated Signals: Using signal generator to create simulated signals to test and calibrate transducers automatic temperature controls is generally recommended overusing sensors as signal generators with simulated conditions or overwritten values.

Q. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test specific sequence is acceptable. Reset setpoint after completing test.

R. Indirect Indicators: Using indirect indicators for responses or performance is permitted only after visually and directly verifying and documenting indirect readings through control system representing actual conditions and responses over tested parameter range.

S. Perform each function and test under conditions simulating actual conditions as close as is practically possible.
   1. Provide materials, system modifications, and other things necessary to produce flows, pressures, temperatures, and other responses to execute test according to specified conditions.
   2. At completion of test, return modified equipment and systems to pretest condition.

3.05 DEFICIENCIES AND TEST APPROVALS

T. Deficiencies:
   1. Commissioning Authority will record and report deficiencies.
   2. Minor deficiencies may be corrected during tests at Commissioning Authority's discretion. Deficiency and resolution will be documented.
   3. When deficiency is identified, Commissioning Authority will discuss issue with party executing test.
      a. When party executing test accepts responsibility to correct deficiency:
         1) Commissioning Authority documents deficiency and executing party's response.

2) Party executing test corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready retesting and submits form to Commissioning Authority.
3) Commissioning Authority reschedules test and test is repeated until satisfactory performance is achieved.

b. When party executing test disputes deficiency or responsibility for deficiency:
1) Commissioning Authority documents deficiency and executing party's response.
2) Commissioning Authority submits deficiency report to Contractor, and party executing test and party believed to be responsible for deficiency.
3) Commissioning Authority negotiates resolution with parties involved and refers continuing disputes to Architect/Engineer for resolution in accordance with Contract Documents.
4) Commissioning Authority documents resolution process.
5) When resolution is decided, appropriate party corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting and submits form to Commissioning Authority.
6) Commissioning Authority reschedules test and test is repeated until satisfactory performance is achieved.

U. Retesting Costs:
1. When verification check and startup or functional performance test deficiency is discovered requiring rescheduling or retesting:
a. Contracting Officer will compensate Commissioning Authority for attending and directing additional testing.
b. Contracting Officer will deduct additional testing compensation from final payment due to Contractor.

V. Provide written report to Commissioning Authority before each scheduled commissioning meeting concerning status of each deficiency. Include explanations of disagreements with resolution proposals for each discrepancy.
1. Commissioning Authority will retain original deficiency forms until end of Project.

W. Manufacturing Defects: When 10 percent, but not less than 3 identical pieces of equipment or equipment with only small size or capacity differences fail to perform to Contract Document requirements due to manufacturing defect, all identical units may be considered defective by Contracting Officer.
1. Within one week of notice from Contracting Officer, examine all other identical units and record findings. Submit findings to Contracting Officer within two weeks of original notice.
2. Within two weeks of original notification, provide signed and dated, written explanation of problem, cause of defect, and proposed solutions meeting Contract Document requirements. Include equipment submittals supporting solution.

3. Contracting Officer will determine whether replacement or repair of all identical units is required.
4. Install two examples of proposed solution. Contracting Officer will test installations for up to one week, before deciding solution is acceptable.
5. Upon acceptance, replace or repair all identical items, at Contractor's expense. Extend warranty accordingly when original equipment warranty had begun.
6. Complete repairs or replacements with reasonable speed beginning within one week from when parts can be obtained.

X. Test Approval: Commissioning Authority notes each satisfactorily demonstrated function on functional performance test form.
1. Commissioning Authority recommends acceptance of each test to Contracting Officer using standard form.
2. Contracting Officer gives final approval for each test using same form, providing signed copy to Commissioning Authority and Contractor.

END OF SECTION

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. General requirements for coordinating and scheduling commissioning.

B. Commissioning meetings.

C. Commissioning reports.

D. Use of test equipment, instrumentation, and tools for commissioning.

E. Prefunctional checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.

F. Commissioning tests and commissioning test demonstration.

G. Adjusting, verifying, and documenting identified systems and assemblies.

1.02 RELATED REQUIREMENTS:

A. Section 013000 "Submittal Procedures" for submittal procedures requirements for commissioning.

B. Section 017000 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.

C. Section 017000 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.

D. Section 019119.43 "Exterior Enclosure Commissioning" for technical commissioning requirements for exterior closure.

E. Section 210800 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.

F. Section 220800 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.

G. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.

H. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

I. Section 270800 "Commissioning of Communications" for technical commissioning requirements for communications systems.

J. Section 280800 "Commissioning of Electronic Safety and Security" for technical commissioning requirements for electronic safety and security systems.

1.03 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, prefunctional checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.

B. Basis-of-Design Document: A document prepared by Owner, Architect, or Commissioning Authority that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Identify Commissioning Authority in Section 011000 "Summary."

D. Commissioning Authority: An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.

E. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning.

F. Coordinate the scope of Commissioning-Process Work with the agreement between Owner and Commissioning Authority and with other Sections specifying Commissioning-Process Work. Include the scope of work from the agreement between Owner and Commissioning Authority in (Section 011000 "Summary.") (Section 011200 "Multiple Contract Summary.")

G. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of commissioning is defined in Section 011200 "Multiple Contract Summary."

H. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date Construction Phase Commissioning Completion is achieved. See Section 017700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.

1. Commissioning is complete when the work specified in this Section and related Sections has been completed and accepted, including, but not limited to, the following:

    a. Completion of tests and acceptance of test results.

    b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.

    c. Comply with requirements in Section 017900 "Demonstration and Training."

    d. Completion and acceptance of submittals and reports.

I. Owner's Project Requirements: A document written by Owner, Architect, or Commissioning Authority that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

J. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Owner-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

K. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

L. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

1.04 COMPENSATION

A. Should Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.

1. Failure to provide timely notice of commissioning activities schedule changes.

2. Failure to meet acceptance criteria for test demonstrations.

B. Contractor shall compensate Owner for such additional services and expenses at the professional's billing rate per labor hour plus travel expenses plus per diem allowances for meals and lodging according to current U.S. General Services Administration (GSA) Per Diem Rates.

1.05 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Communications with Contractor should be conveyed by Architect, even when recommendations originate with Commissioning Authority.

2. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning.

3. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning.

4. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning.

5. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning.

2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning.

3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.

1.06 SUBMITTALS

A. Comply with requirements in Section 013000 "Submittal Procedures" for submittal procedures general requirements for commissioning.

B. INFORMATIONAL SUBMITTALS

1. Commissioning Plan Information:

   a. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors to the performance of the various commissioning requirements.

   b. Schedule of commissioning activities, integrated with the construction schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for construction schedule general requirements for commissioning.

   c. Contractor personnel and subcontractors to participate in each test.

   d. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

2. Commissioning schedule.

3. Two-week look-ahead schedules.

4. Commissioning Coordinator Letter of Authority:

   a. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

      1) Make inspections required for commissioning.

      2) Coordinate, schedule, and manage commissioning of Contractor, subcontractors, and suppliers.

      3) Obtain documentation required for commissioning from Contractor, subcontractors, and suppliers.

      4) Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

5. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

   a. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of three previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

6. List test instrumentation, equipment, and monitoring devices. Include the following information:

   a. Make, model, serial number, and application for each instrument, equipment, and monitoring device.

b. Brief description of intended use.

c. Calibration record showing the following:

1) Calibration agency, including name and contact information.

2) Last date of calibration.

3) Range of values for which calibration is valid.

4) Certification of accuracy.

5) N.I.S.T. traceability certification for calibration equipment.

6) Due date of the next calibration.

7. Test Reports:

a. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed prefunctional checklists.

b. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.

c. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.

d. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.

e. Data Trend Logs: Submit data trend logs at the end of the trend log period.

f. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit print-out of log of alarms that occurred since the last log was printed.

8. Prefunctional Checklists:

a. Material checks.

b. Installation checks.

c. Startup procedures, where required.

C. CLOSEOUT SUBMITTALS

1. Commissioning Report Supporting Documentation:

a. At Construction Phase Commissioning Completion, submit the following commissioning work of Contractor:

b. Pre-startup reports.

c. Approved test procedures.

d. Test data forms, completed and signed.

e. Commissioning issues report log.

f. Commissioning issues reports showing resolution of issues.

g. Correspondence or other documents related to resolution of issues.

h. Other reports required by commissioning.

i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.

2. Request for Certificate of Construction Phase Commissioning Completion.

3. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.

2. Certification of commissioning process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.

a. Certified Commissioning Professional, by Building Commissioning Association.

b. Commissioning Process Management Professional, by American Society of Heating, Refrigerating and Air-Conditioning Engineers.

c. Accredited Commissioning Process Authority Professional, by University of Wisconsin.

d. Accredited Commissioning Process Manager, by University of Wisconsin.

e. Accredited Green Commissioning Process Provider, by University of Wisconsin.

B. Calibration Agency Qualifications: Certified by The American Association of Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

1.08 COMMISSIONING AUTHORITY'S RESPONSIBILITIES

A. Commissioning Authority Responsibilities: Comply with requirements in [**Section 011000 "Summary."**] [**Section 011200 "Summary of Multiple Contracts."**]

PART 2 PRODUCTS

2.01 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.

2. Calibrated and certified.

    a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags permanently affixed.

    b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

3. Maintain test equipment and instrumentation.

4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.02 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.

2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.03 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Retain two subparagraphs below for projects requiring electronic submittals; delete for projects requiring only hard-copy submittals.

2. Record report on compact disk.

3. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report Supporting Documentation:

1. Include a table of contents and an index to each test.

2. Include major tabs for each Specification Section.

3. Include minor tabs for each test.

4. Within each minor tab, include the following:

    a. Test specification.

    b. Pre-startup reports.

    c. Approved test procedures.

    d. Test data forms, completed and signed.

PART 3 EXECUTION

3.01 PREPARATION

A. Review preliminary prefunctional checklists and preliminary test procedures and data forms.

3.02 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning with the construction schedule.

B. Perform activities identified in prefunctional checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using 230800 and 260800.

2. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.

3. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.

2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.03 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.

2. Obtain, assemble, and submit commissioning documentation as highlighted in Part 2 of this specification section.

3. Coordinate first subparagraph below with Section 013100 "Project Management and Coordination."

4. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."

5. Coordinate the commissioning schedule with the commissioning authority. Integrate commissioning schedule into the construction schedule. Update schedule at specified intervals.

6. Review and comment on preliminary test procedures and data forms.

7. Report inconsistencies and issues in system operations.

8. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.

9. Direct and coordinate test demonstrations.

10. Coordinate witnessing of test demonstrations by Owner's witness.

11. Coordinate and manage training. Be present during training sessions to direct video recording, present training and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."

12. Prepare and submit specified commissioning reports.

13. Track commissioning issues until resolution and retesting is successfully completed.

14. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.

15. Assist the Cx Authority in assembly and submittal of the commissioning report.

3.04 COMMISSIONING TESTING

A. Quality Control: Prefunctional checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published commissioning schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning.

C. Prefunctional Checklists:

1. Complete prefunctional checklists as Work is completed.

2. Distribute prefunctional checklists to installing contractors before they start work.

3. Installers:

a. Verify installation using approved prefunctional checklists as Work proceeds.

b. Complete and sign prefunctional checklists daily for work performed during the preceding day.

4. Provide Commissioning Authority access to prefunctional checklists as they are completed.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with prefunctional checklists. Record installation compliance issues on the prefunctional checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.

2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.

3. Completed test data forms are the official records of the results of tests.

4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.

5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.

b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.

6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."

7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.

2. Perform and complete each step of the approved test procedures in the order listed.

3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.

4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.

5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results re-submitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100percent unless otherwise indicated in the individual test specification.

2. Notify Owner's witness at least five daysin advance of each test demonstration.

3. Perform and complete each step of the approved test procedures in the order listed.

4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.

5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.

6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.

    a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

    a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:

1. Deferred Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction Phase Commissioning Completion as follows:

    a. Identify deferred tests by number and title.

    b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least five working days(minimum) in advance of tests.

3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction Phase Commissioning Completion. Include the following in the request for Certificate of Construction Phase Commissioning Completion:

    a. Identify delayed tests by test number and title.

    b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least five working days(minimum) in advance of tests.

3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.

2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.

3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If an issue cannot be resolved within five minutes of failure, the test will need to be rescheduled. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for participation in the repeated demonstration.

4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:

a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.

b. Submit commissioning compliance issue report form within 48 hoursof the test.

c. Determine the cause of the failure.

d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

   a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.

   b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.

   c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.

   d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.

6. Diagnose and correct failed test demonstrations as follows:

   a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.

   b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.

   c. Record the results of each step of the diagnostic procedure.

   d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.

   e. Determine and record corrective measures.

   f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.

7. Retest:

   a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness

on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.

b. For each repeated test demonstration, submit a new test data form, marked "Re-test."

8. Do not correct commissioning compliance issues during test demonstrations.

a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.05 COMMISSIONING MEETINGS

A. Commissioning Authority will schedule and conduct commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."

3.06 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Prefunctional Checklists:

a. Material checks.

b. Installation checks.

c. Start up, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.

d. Performance Tests:

1) Static tests, as appropriate.

2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.

3) Equipment and assembly performance tests.

4) System performance tests.

5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to prefunctional checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.07 SCHEDULING

A. Commence commissioning as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning into Contractor's construction schedule. See Section 013200 "Construction Progress Documentation."

1. Include detailed commissioning activities in monthly updated Contractor's construction schedule and short interval schedule submittals.

2. Schedule the start date and duration for the following commissioning activities:

a. Submittals.

b. Preliminary operation and maintenance manual submittals.

c. Installation checks.

d. Startup, where required.

e. Performance tests.

f. Performance test demonstrations.

g. Commissioning tests.

h. Commissioning test demonstrations.

3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.

4. Determine milestones and prerequisites for commissioning. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning.

2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.

3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Owner.

2. Notify Owner of commissioning schedule changes at least five work days in advance for activities requiring the participation of Owner's witness.

3.08 CERTIFICATE OF CONSTRUCTION PHASE COMMISSIONING COMPLETION

A. When Contractor considers that construction phase commissioning, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction phase commissioning or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction Phase Commissioning Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction Phase Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction phase commissioning completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction phase commissioning or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction Phase Commissioning that shall establish the date of completion of construction phase commissioning. Certificate of Construction Phase Commissioning Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 01 91 13

Brightly Inventory/Asset List
[for completion post-commissioning]

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SECTION 019119.43 - EXTERIOR ENCLOSURE COMMISSIONING

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

A. Section includes building enclosure Cx process requirements for the above- and below-grade systems and assemblies:

1. Opaque walls.
2. Roofs.
3. Openings.
4. Interfaces.

B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general requirements for Cx processes including definitions, Cx team membership, Owner's responsibilities, Contractor's responsibilities, and CxA's responsibilities.

1.03 DEFINITIONS

A. Building Enclosure: Materials, components, systems, and assemblies intended to provide shelter and environmental separation between interior and exterior, or between two or more environmentally distinct interior spaces in a building or structure. The building enclosure includes, but is not limited to, exterior walls, above and below grade, and roof assemblies.

B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."

C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."

D. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Prefunctional Checklists: Draft Prefunctional Checklists will be created by CxA for Contractor review.

C. Prefunctional Checklists: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for Construction Checklists:

1. Completion of exterior enclosure, including:

a. Exterior cladding

b. Vapor barrier

c. Roof deck

D. Cx Process Submittals:

1. Test Reports: Prepared by a qualified testing agency for each test.

2. Record Drawings: As-built drawings of mockups showing changes made during testing.

E. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For building envelope systems and components to include in operation and maintenance manuals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION CHECKLISTS

A. Prepare detailed Prefunctional Checklists for exterior enclosure Cx systems, subsystems, equipment, and components. Complete and submit Construction Checklists.

3.02 CONSTRUCTION CHECKLIST REVIEW

A. Review and provide written comments on draft Prefunctional Checklists. CxA will create required draft Prefunctional Checklists and provide them to Contractor.

B. Return draft Prefunctional Checklist review comments within [**10**] <**Insert number**> days of receipt.

C. When review comments have been resolved, CxA will provide final Prefunctional Checklists, marked "Approved for Use, (date)."

D. Use only Prefunctional Checklists, marked "Approved for Use, (date)."

3.03 GENERAL TESTING REQUIREMENTS

A. If tests cannot be completed because of a deficiency outside the scope of the building enclosure systems, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

B. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

C. Coordinate schedule with, and perform Cx activities at the direction of the CxA.

3.04 BUILDING ENCLOSURE TESTING

A. Building Enclosure Testing: Perform testing before installation of interior finishes unless otherwise indicated.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Expansion Building Enclosure Testing: Perform the following tests in the following order:

1. Whole Building Air Leakage Rate by Fan Pressurization: ASTM E 779.

a. Maximum Air Leakage Rate: 0.35 CFM/SF of room surface area.

END OF SECTION 01 91 19.43

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SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 REFERENCE STANDARDS

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

1.03 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company with demonstrated experience in the type of work required.

PART 3 EXECUTION

2.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Obtain required permits.

2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.

3. Provide, erect, and maintain temporary barriers and security devices.

4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.

5. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.

6. Occupied Facilities: Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.

7. Obtain written permission from Owner when demolition equipment will traverse, infringe upon, or limit access to adacent buildings and parking.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements to remain in place and not removed.

1. Provide bracing and shoring.

2. Prevent movement or settlement of adjacent structures.

3. Stop work immediately if adjacent structures appear to be in danger.

D. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

E. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

2.02 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities where indicated on drawings.

2.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction indicated on drawings are based on casual field observation and existing record documents only.

1. Verify construction and utility arrangements are as indicated.

2. Report discrepancies to Architect before disturbing existing installation.

3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

C. Remove existing work as indicated and required to accomplish new work.

1. Remove items indicated on drawings.

2. Temporarily store and maintain items indicated on drawings for re-use.

3. Prepare and ready work that is existing-to-remain to receive new work indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated on Drawings.

1. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

2. Remove abandoned pipe, ducts, conduits, and equipment. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

E. Protect existing work to remain.

1. Prevent movement of structure. Provide shoring and bracing as required.

2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.

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

4. Patch to match new work.

2.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Comply with all federal, state, and local regulations regarding the disposal of known hazardous materials.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.

2. Welded-wire reinforcement.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.

2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage .

1. Store reinforcement to avoid contact with earth.

PART 2 PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 , deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.02 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 EXECUTION

3.01 PREPARATION

A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.02 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.

2. Stagger splices in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.

3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

4. Lace overlaps with wire.

3.03 INSTALLATION TOLERANCES

A. Comply with ACI 117.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Concrete mixture materials.
4. Concrete mixture class types.
5. Concrete mixing.

B. Related Requirements:

1. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
2. ACTION SUBMITTALS

C. Product Data:

1. Portland cement.
2. Aggregates.
3. Admixtures:
    a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
4. Curing materials.
    a. Design Mixtures: For each concrete mixture, include the following:
5. Mixture identification.
6. Compressive strength at 28 days or other age as specified.
7. Compressive strength required at stages of construction.
8. Durability exposure classes for Exposure Categories F, S, W, and C.
9. Maximum w/cm ratio.
10. Slump or slump flow limit.
11. Air content.
12. Nominal maximum aggregate size.

13. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

D. QUALITY ASSURANCE

E. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

F. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.

G. DELIVERY, STORAGE, AND HANDLING

H. Comply with ASTM C94/C94M and ACI 301.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

2. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I.

2. Normal-Weight Aggregates:

3. Coarse Aggregate: ASTM C33/C33M,

4. Maximum Coarse-Aggregate Size: 3/4 inch nominal.

5. ADMIXTURES

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. CONCRETE MIXTURE MATERIALS

E. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

F. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

PART 3 EXECUTION

3.01 TOLERANCES

A. Comply with ACI 117.

3.02 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.

B. 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. Level concrete, cut high areas, and fill low areas.

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.

6. Do not further disturb slab surfaces before starting finishing operations.

3.03 APPLICATION OF FINISHING FLOORS AND SLABS

A. Trowel Finish:

1. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

2. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

3. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.

4. Apply a trowel finish to surfaces exposed to view .

5. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

a. Slabs on Ground:

1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.

2) Suspended Slabs:

3) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.

4) APPLICATION OF FINISHING FORMED SURFACES

B. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.

b. Remove projections larger than 1 inch.

c. Tie holes do not require patching.

d. Surface Tolerance: ACI 117, Class D.

e. Apply to concrete surfaces for metal lap pan deck formed surfaces and those surfaces that are buried or covered with subsequent installed surfaces.

2. ACI 301 (ACI 301M) Surface Finish SF-3.0:

a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.

b. Remove projections larger than 1/8 inch.

c. Patch tie holes.

d. Surface Tolerance: ACI 117 Class A.

e. Locations: Apply to concrete surfaces exposed to public view, .

C. Rubbed Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Grout-Cleaned Rubbed Finish:

a. Clean concrete surfaces after contiguous surfaces are completed and accessible.

b. Do not clean concrete surfaces as Work progresses.

c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

d. Wet concrete surfaces.

e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

f. INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

D. Filling in:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.

2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.

3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

E. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.

5. Prior to pouring concrete, place and secure anchorage devices.

a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

b. Cast anchor-bolt insert into bases.

c. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.

2. Screed, tamp, and trowel finish concrete surfaces.

3.04 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 for cold weather protection during curing.

2. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

3. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

4. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

5. Begin curing after finishing concrete.

6. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

            (a) Lap edges and ends of absorptive cover not less than 12 inches.

            (b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

        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, and sealed by waterproof tape or adhesive.

            (a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

            (b) Floors To Receive Curing and Sealing Compound:

        3) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        4) Recoat areas subjected to heavy rainfall within three hours after initial application.

        5) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. ACTION SUBMITTALS

C. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Shop primer.
6. Shrinkage-resistant grout.

D. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
4. Identify members not to be shop primed.

E. INFORMATIONAL SUBMITTALS

F. Qualification Data: For fabricator .

G. Mill test reports for structural-steel materials, including chemical and physical properties.

H. 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).

I. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. STRUCTURAL-STEEL MATERIALS

C. W-Shapes: ASTM A992/A992M .

D. Channels, Angles, M- and S-Shapes: ASTM A36/A36M .

E. Plate and Bar: ASTM A36/A36M .

F. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

G. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: Extra strong .
2. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS AND CONNECTORS

A. 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.

2.03 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.

1. Fabricate beams with rolling camber up.
2. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.

3. Mark and match-mark materials for field assembly.

4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.04 GALVANIZING/COATING

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. SHOP PRIMING

B. 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. Galvanized surfaces .

5. Surfaces enclosed in interior construction.

C. Restraint Posts: Coat with ARCote 9700 electric wire arc spray zinc metalizing system.

D. 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.

2. SOURCE QUALITY CONTROL

E. Testing Agency: 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. 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. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

d. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.

e. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 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. Snug-tighten 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.

3. 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.

3.02 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: Snug tightened .

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. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.03 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: 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."

END OF SECTION

SECTION 05 31 00 - STEEL DECKING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.
3. Related Requirements:
4. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
5. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
6. ACTION SUBMITTALS

B. Product Data:

1. Roof deck.
2. Composite floor deck.
3. Shop Drawings:
4. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. INFORMATIONAL SUBMITTALS

D. Welding certificates.

E. Product Certificates: For each type of steel deck.

F. Field Quality-Control Submittals:

1. Field quality-control reports.

G. QUALITY ASSURANCE

H. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. ACCESSORIES

C. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

H. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth .

I. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

J. 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.

K. Galvanizing Repair Paint: ASTM A780/A780M .

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

G. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

H. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.02 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 3/4 inch , nominal.

2. Weld Spacing:

a. Space and locate welds as indicated.

3. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 12 inches, and as follows:

4. Fasten with a minimum of 1-1/2-inch- long welds.

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches , with end joints as follows:

1. End Joints: Lapped .

C. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

D. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

E. FIELD QUALITY CONTROL

F. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

G. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

    a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

    b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.

H. Prepare test and inspection reports.

END OF SECTION

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cold-formed steel framing.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

PART 2 PRODUCTS

2.01 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Steel Thickness: As Indicated on the drawings.

2. Flange Width: As indicated on the drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Steel Thickness: As indicated on the drawings .

2. Flange Width: 1-1/2 inches and as indicated on the drawings.

2.02 JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, punched with standard holes with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch and as indicated on the drawings.

2. Flange Width: 1-5/8 inches, minimum, and as indicated on the drawings.

B. Steel Rim Joist Track: Manufacturer's standard U-shaped steel rim joist track, of web depths indicated unpunched or punched at joist spacing, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch, minimum, and as indicated on the drawings.

2. Flange Width: 1-1/2 inches, minimum, and as indicated on the drawings.

2.03 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic-coated steel sheet, of same grade and coating designation 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.

2.04 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, in accordance with AISI S240 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 steel framing members as indicated on the drawings.

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 and install as indicated on the drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

PART 3 EXECUTION

3.01 INSTALLATION OF COLD-FORMED STEEL FRAMING

A. Install cold-formed steel framing in accordance with ASTM C1007, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

B. 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.

C. 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. Locate mechanical fasteners, install as indicated in the drawings, and comply with requirements for spacing, edge distances, and screw penetration.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

3.02 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Squarely seat studs against top and bottom track, 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 track.

B. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

C. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

D. Align floor and roof framing over studs in accordance with AISI S240, Section C3.5.2. Where framing cannot be aligned, continuously reinforce track to transfer loads.

E. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

F. Install headers over wall openings wider than stud spacing. Locate headers as indicated in the drawings. 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 as indicated on the drawings. Fasten jamb members together to uniformly distribute loads.

2. Install track and jack studs above and below wall openings. Anchor track to jamb studs with clip angles or by welding and space jack studs same as full-height wall studs.

G. 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.

H. Install horizontal bridging in stud system as indicated on the drawings, spaced vertically 48 inches. 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 in accordance with manufacturer's written instructions.

I. 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.

3.03 INSTALLATION OF JOIST FRAMING

A. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing as indicated on drawings.

2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

B. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

C. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

D. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

E. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

END OF SECTION

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stair railings and guardrails, shop primed for field finishing.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating.

1.03 REFERENCE STANDARDS

A. AISC 207 - Standard for Certification Programs; 2025.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

E. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.

F. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

G. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

B. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

C. Fabricator Qualifications:

1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 207.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Design new railing assemblies to match existing railings in stairwell modified in the project.

C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

E. Allow for expansion and contraction of members and building movement without damage to connections or members.

F. Dimensions: See drawings for configurations and heights.

G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

H. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.

C. Steel Plates: ASTM A283/A283M.

D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

E. Exposed Fasteners: Stainless steel flush countersunk screws or bolts with neoprene washers; consistent with design of railing.

F. Shop Primer and Touch-Up Primer: SSPC-Paint 15.

G. Design: As depicted on Drawings; match existing railing system design and finish unless noted otherwise.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.

2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

D. Mechanically fasten anchors to parapet wall as indicated on drawings.

END OF SECTION

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SECTION 05 53 05 - METAL GRATINGS AND FLOOR PLATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed metal stair tread and landing gratings.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).

E. NAAMM MBG 531 - Metal Bar Grating Manual; 2009.

F. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.03 SUBMITTALS

A. Product Data: Provide span and deflection tables.

B. Shop Drawings: Indicate existing component supports, new required component supports, openings, perimeter construction details, and tolerances.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design Live (Pedestrian) Load: Uniform load of 150 lb/sq ft minimum; concentrated load of 300 lbs.

B. Maximum Allowable Deflection Under Live Load: 1/120 of span; size components by single support design.

C. Maximum Spacing Between Bars: To restrict pedestrian shoe heels.

2.02 MATERIALS

A. Steel Framing: ASTM A36/A36M shapes, galvanized per ASTM A123/A123M.

B. Cross Bars: ASTM B211 ASTM B211M solid bars.

C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

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

2.03 ACCESSORIES

A. Fasteners and Saddle Clips: Galvanized steel:

2.04 FABRICATION

A. Grating Type: NAAMM MBG 531, Welded Type.

B. Weld joints of intersecting metal sections.

C. Top Surface: Non-slip.

D. Cross Bars: Spaced 4 inches on center.

2.05 FINISHES

A. Galvanizing for Steel Shapes: ASTM A123/A123M.

B. Galvanizing for Steel Hardware: ASTM A153/A153M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify that opening sizes and dimensional tolerances are acceptable.

C. Verify that supports are correctly positioned.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Mechanically cut galvanized finish surfaces. Do not flame cut.

C. Touch-up galvanized finish impacted during installation using galvanizing repair paint.

D. Secure to prevent movement.

END OF SECTION

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preservative treated wood materials.

B. Fire retardant treated wood materials.

1.02 RELATED REQUIREMENTS

A. Section 07 72 00 - Roof Accessories: Roof curbs.

B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.

C. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.

D. PS 1 - Structural Plywood; 2009.

E. PS 20 - American Softwood Lumber Standard; 2015.

1.04 SUBMITTALS

A. Product Data: Provide technical data on wood preservative materials and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.06 COORDINATION AND USE

A. Use fire-retardant treated wood materials at the following locations:

1. Incidental blocking in roof assemblies.

2. Incidental blocking in non-bearing exterior walls.

3. Blocking and nailers used under expansion joint cover assemblies at fire-rated separation walls.

4. As specifically shown on the Drawings.

B. Use preservative treated wood materials at the following locations:

1. Exterior door and window bucks.

2. Nailers for parapet caps and equipment curbs.

3. As specifically shown on the Drawings.

C. Use of non-treated wood materials is acceptable only at the following locations:

1. Blocking and backing at stair railings.

2. Doors, door frames, and interior millwork.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.

2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

3. Provide fire-retardant treated wood at all locations in the Project, unless indicated otherwise on the Drawings.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No.2 or Standard Grade.

2. Boards: Standard or No.3.

D. Window and Door Bucks: 1-1/2 inch thick laminated strand lumber.

E. Parapet Caps: 1-1/2 inch thick lumber or laminated strand lumber.

2.03 CONSTRUCTION PANELS

A. Plywood Backing Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.

2.04 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:

1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.

a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

b. Do not use treated wood in direct contact with ground.

C. Preservative Treatment:

1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to ____ lb/cu ft retention.

a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.

b. Treat lumber in contact with roofing, flashing, or waterproofing.

c. Treat lumber in contact with masonry or concrete.

d. Treat lumber less than 18 inches above grade.

2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.

    a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.

    b. Treat plywood in contact with roofing, flashing, or waterproofing.

    c. Treat plywood less than 18 inches above grade.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide backing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is shown .

3.03 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.04 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.

1. Comply with applicable regulations.

2. Do not burn scrap on project site.

3. Do not burn scraps that have been pressure treated.

4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

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SECTION 06 16 00 - SHEATHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Related Requirements:
4. Section 061000 "Rough Carpentry" for plywood backing panels.
5. ACTION SUBMITTALS

B. Product Data: For each type of product. Indicate component materials and dimensions and include construction and application details.

PART 2 PRODUCTS

2.01 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 in accordance with 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 ft. beyond the centerline of the burners at any time during the test.

1. Treatment must not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated on Drawings.
3. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

C. Application: Treat all plywood unless otherwise indicated.

1. Roof sheathing.
2. WALL SHEATHING

D. Plywood Sheathing, Walls:

1. Classification: DOC PS 1 , Exposure 1 sheathing.

2. Span Rating: Not less than 32/16 .

3. Nominal Thickness: Not less than 1/2 inch .

E. ROOF SHEATHING

F. Plywood Sheathing, Roofs:

1. Classification: , Exposure 1 sheathing.

2. Span Rating: Not less than 48/24 .

3. Nominal Thickness: Not less than 3/4 inch.

G. MISCELLANEOUS MATERIALS

H. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacturer.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M .

2. Nails, Brads, and Staples: ASTM F1667.

I. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

J. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended in writing by screw manufacturer for material being fastened.

PART 3 EXECUTION

3.01 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. Arrange joints so that pieces do not span between fewer than three support members.

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. Table 2304.10.1, "Fastening Schedule," in the ICC's "International Building Code."

2. ICC-ES evaluation report for fastener.

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.

3.02 INSTALLATION OF WOOD STRUCTURAL PANELS

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

a. Screw to cold-formed metal framing.

b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at exterior wall behind new wall finish and other miscelleneous locations indicated on Drawings. For board insulation in roof assemblies, see Section 07 53 00.

B. Batt insulation in wall and roof construction.

1.02 RELATED REQUIREMENTS

A. Section 07 21 19 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.

B. Section 07 53 00 - Elastomeric Membrane Roofing: Insulation specified as part of roofing system.

C. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

D. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

G. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) carbon black board.

B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

C. Insulation Over Roof Deck: As specified in 07 53 00.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Complies with ASTM C578, and manufactured using carbon black technology.

1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.

2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

3. Board Size: 48 inch by 96 inch.

4. Board Thickness: 1-3/4 inch.

5. Board Edges: Shiplap, at long edges.

2.03 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.

2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.

3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.

4. Formaldehyde Content: Zero.

5. Thickness: 6 inch and 1.5 inch, and as indicated otherwise on Drawings.

6. Facing: Unfaced.

7. Manufacturers:

a. CertainTeed Corporation: www.certainteed.com.

b. Johns Manville: www.jm.com.

c. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

d. Or equal.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.

2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

3. Thickness: Install in thickness required to fill stud cavity, and as indicated otherwise on Drawings.

4. Manufacturers:

a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.

b. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.

c. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.

d. Or equal.

2.04 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

B. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.

C. Adhesive: Gun grade, interior and exterior, and compatible with insulation and substrates; complies with ASTM C557.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards vertically on walls.

1. Place boards to maximize adhesive contact.

2. Butt edges and ends tightly to adjacent boards and to protrusions.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Tape insulation board joints.

3.03 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in wall and ceiling spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.

1. At junctions of parapet walls and roof assemblies as indicated on Drawings.

2. Miscellaneous applications in exterior framed walls.

3. Miscellaneous applications in wall crevices.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.

B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

E. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

1.03 SUBMITTALS

A. Product Data: Provide product description, insulation properties, and preparation requirements.

B. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

1.04 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.01 MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.

1. Thermal Resistance: R-value of 5.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.

2. Water Vapor Permeance: Vapor retarder; 1.0 perm, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.

3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.

4. Air Permeance: 0.04 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf.

5. Closed Cell Content: At least 90 percent.

6. Surface Burning Characteristics: Class A; Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

7. Manufacturers:

    a. BASF Corporation; WALLTITE US: www.spf.basf.com.

    b. DAP Products Inc.; Touch'n Foam Professional: www.dap.com.

    c. Gaco Western; GacoOnePass F1850R: www.gaco.com.

    d. Icynene Inc; Icynene ProSeal: www.icynene.com.

    e. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com.

    f. Or other manufacturer approved by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply insulation by spray method, to a uniform monolithic density without voids.

C. Patch damaged areas, whether they occur in the fabrication facility or in the field.

D. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

E. If none exists, apply acceptable thermal barrier separation between foamed-in-place insulation and interior atmosphere of building in accordance with the International Building Code.

3.03 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

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SECTION 07 25 00 - WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vapor Retarders: Materials to make exterior walls water vapor resistant and air tight.

B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

C. Self-Adhesive Sheet Membrane Flashing: Materials that make joints around openings in exterior walls water vapor resistant and airtight.

D. For self-adhered sheet membrane underlayment at metal roofs, see Section 07 41 13.

1.02 RELATED REQUIREMENTS

A. Section 07 41 13 - Metal Roof Panels: high temperature self-adhered underlayment at metal roofs.

1.03 SUBMITTALS

A. Product Data: Provide data on material characteristics.

B. Manufacturer's Installation Instructions: Indicate preparation and installation methods.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

A. Air Barrier: System shall consist of air barrier and tape and shall provide continuous enclosure of all heated building spaces and shall be highly resistant to passage of air through or around the system, but shall allow for passage of water vapor.

1. On outside surface of sheathing of exterior walls use air barrier sheet, self-adhesive type.

B. Interior Vapor Retarder: System shall consist of vapor retarder and vapor retarder tape to provide continuous enclosure of all heated building spaces and shall be highly resistant to passage of water vapor or air through or around the system.

1. On inside face of studs of exterior walls, under wall finish.

C. Self-Adhesive Sheet Membrane (SASM): For locations other than under metal roof panels; system shall consist of self-adhesive sheet membrane to provide weather and vapor resistance at terminations of air barrier and vapor retarder systems and at openings in walls and roofs.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Self-Adhered:

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.

3. Water Penetration Resistance Around Nails: Pass, when tested in accordance with ASTM D1970/D1970M (modified).

4. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 180 days of weather exposure.

5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.

6. Seam and Perimeter Tape: As recommended by sheet manufacturer.

7. **Basis-of-Design Product: VaproShield, LLC; WrapShield SA - Self-Adhered: www.vaproshield.com.**

2.03 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Vapor Retarder Sheet: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for application indicated. Single ply polyethylene is prohibited.

1. Water Vapor Permeance: .045 perm, maximum, when tested in accordance with ASTM E96/E96M.

2. Seam and Perimeter Tape: Polyethylene self adhering type, 4 inches wide, compatible with sheet material, as recommended by Vapor Retarder manufacturer.

3. Product:

a. Rufco 300 by Raven Industries.

b. Griffolyn Type 105.

c. Or other product approved by Architect.

2.04 SELF-ADHESIVE SHEET MEMBRANE (SASM)

A. Self-Adhesive Sheet Membrane Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.

1. Composition: Rubber-modified asphalt sheet; self adhering; with strippable release film.

2. Sheet Thickness: 40 mil (0.040 inch) minimum total thickness.

3. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.

4. Water Vapor Permeance: 0.067 perm, maximum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant method).

5. Applications: For sealing rough openings in the exterior building envelope from air, water, and vapor intrusion; and as indicated on the Drawings. For SASM roof underlayment, see 07 41 13 - Metal Roof Panels.

6. Products:

   a. Henry Company; Blueskin PE200HT: www.henry.com/#sle.

   b. GCP Applied Technologies; Grace Ice and Water Shield; www.gcpat.com/en.

   c. Or other product approved by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Vapor Retarders: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Mechanically Fastened Sheets - Vapor Retarder On Interior:

1. When insulation is to be installed in assembly, install vapor retarder over insulation.

2. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, making airtight seal.

3. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.

4. Seal entire perimeter to structure, window and door frames, and other penetrations.

5. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain air tight seal.

E. Self-Adhesive Sheets:

1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.

2. Lap sheets shingle-fashion to shed water and seal laps airtight.

3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.

4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.

5. At wide joints, provide extra flexible membrane allowing joint movement.

F. Openings and Penetrations in Exterior Weather Barriers: Install as follows, unless indicated otherwise on Drawings:

1. Install SASM flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.

3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.

4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.

5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Do not cover installed weather barriers until required inspections have been completed.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 41 13 - METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural roofing systems of preformed standing seam metal panels for installation over existing substrate.

B. Attachment system.

C. Finishes.

D. Accessories including high temperature underlayment.

1.02 RELATED REQUIREMENTS

A. Section 07 72 00 - Roof Accessories: Curbs and snow guards.

B. Section 07 92 00 - Joint Sealants: Sealant at joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2025a.

B. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

C. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2011.

D. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Storage and handling requirements and recommendations.

2. Installation methods.

3. Specimen warranty.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.

1. Show work to be field-fabricated or field-assembled.

2. Include structural analysis signed and sealed by qualified structural engineer registered in Alaska, indicating conformance of roofing system and adequacy of roofing attachment to specified loading conditions including wind, snow and seismic loads.

C. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

D. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 WARRANTY

A. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of twenty years from Date of Substantial Completion.

B. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Roof Panels:

1. AEP Span; Span-Lok HP Metal Roofing: www.aepspan.com.

2. The Bryer Company; TBC-Superseam: www.thebryercompany.com.

3. Centria, a Nucor Company; SDP 200: www.centria.com

4. Or other manufacturer approved by Architect.

2.02 ARCHITECTURAL METAL ROOF PANELS

A. Architectural Metal Roofing: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

1. Uplift Capacity: System meets UL-580 Class 90.

B. Standing Seam Metal Roofing: Formed panels with factory-applied finish, mechanically seamed installation in the fiel.

1. Steel Panels:

a. Aluminum-zinc alloy-coated steel conforming to ASTM A792/A792M; minimum AZ50 coating.

b. Steel Thickness: Minimum 24 gage (0.024 inch).

2. Profile: Standing seam, with minimum 2.0 inch seam height; concealed fastener system lapped seam in standing seam profile.

3. Texture: Smooth, with intermediate ribs for added stiffness.

4. Rib Spacing: 16 inches on center.

5. Length: Full length of roof slope, without lapped horizontal joints.

6. Width: Maximum panel coverage of 16 inches.

2.03 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 FABRICATION

A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

2.05 FINISHES

A. Fluoropolymer Coating System: Manufacturer's standard multi-coat thermocured coating system, including minimum 70 percent fluoropolymer color topcoat with minimum total dry film thickness of 0.9 mil; color and gloss to be selected by Owner from manufacturer's full range of available colors..

2.06 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide manufacture flashings, trim, closure strips, preformed crickets, and caps of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:

1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane, as recommended by manufacturer.

2. Concealed Sealant: Non-curing butyl sealant or tape sealant, as recommended by manufacturer.

D. High Temperature Underlayment: Self-adhering, non-asphaltic, high temperature sheet; 10.2 mil total thickness; with strippable siliconized release film on bottom side and slip-resistant and UV-stable facing on top side.

1. Service Temperature: Minus 40 degrees Fahrenheit to 270 degrees Fahrenheit.

2. Water Vapor Permeance: 0.0173 perm, when tested in accordance with ASTM E96/E96M Procedure A (desiccant method).

3. Flammability: Class A when tested in accordance with ASTM E84.

4. **Basis-of-Design Product: The Bryer Company, Titanium PSU 30: www.thebryercompany.com.**

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.

B. Separate dissimilar metals by applying a bituminous coating, self-adhering sheet, or other permanent method approved by roof panel manufacturer.

C. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.

1. Install high temperature underlayment, shingle-lapping successive layers; follow manufacturer's written installation instructions.

2. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.

3. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.

B. Accessories: Install all components required for a complete roofing assembly, including flashings, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.

1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.

2. Install sealant or sealant tape, as recommended by panel manufacturer, at end laps and side joints.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

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SECTION 07 42 13.19 - INSULATED METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory-assembled metal panel system for walls, with trim, related flashings and accessory components.

1.02 RELATED REQUIREMENTS

A. Section 07 21 19 - Foamed-In-Place Insulation.

B. Section 07 25 00 - Weather Barriers.

1.03 REFERENCE STANDARDS

A. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

B. FM 4880 - Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems; 2010.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer documentation on tested structural, thermal, and fire resistance capabilities of assembled panel.

B. Shop Drawings: Indicate dimensions, panel profile and layout, spans, joints, construction details, and methods of anchorage.

C. Samples for Selection: Submit finish samples of manufacturer's full range of available colors and finishes, illustrating color, sheen, and texture.

D. Samples for Verification: Submit two samples of selected panel finish, 3 inch x 2 inch in size illustrating finish color, sheen, and texture.

E. Manufacturer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store pre-finished material off ground with weather protection to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that could cause discoloration or staining.

1.07 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.08 WARRANTY

A. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Insulated Metal Wall Panels:

1. **Kingspan Insulated Panels, Inc.; QuadCore Optimo wall panel: www.kingspan.com.**

2.02 PERFORMANCE / DESIGN CRITERIA

A. Metal Panel System: Factory-assembled metal panel system, with trim, related flashings and accessory components.

1. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

2. Accommodate tolerances of building structural framing.

B. Performance Requirements:

1. Thermal Performance: Provide thermal resistance through entire system; R-value of 24, minimum.

2. Structural Performance: Design and size to withstand all dead loads and wind loads caused by positive and negative wind pressure acting normal to plane of panel.

a. Verify structural performance in accordance with ASTM E330/E330M, using test pressure 1.5 times design wind pressure, with 10 seconds duration of maximum load.

3. Fire Resistance: Class 1 fire rated, without height limitation, when tested in accordance with FM 4880.

4. Movement: Accommodate the movement caused by the following without damage to system, components, or deterioration of seals:

a. Normal movement between system components.

b. Seasonal temperature cycling.

c. Deflection of structural support framing,

2.03 COMPONENTS

A. Wall Panels: Exterior and interior metal sheet skin, factory-assembled, with foamed-in-place insulation; exterior and interior sheet interlocking at edges, fitted with continuous gaskets.

1. Profile: Flat; horizontal panels.

2. Panel Thickness: 3 inch.

3. Exterior Sheet: Pre-finished galvanized steel, 22 gauge, 0.0299 inch minimum base metal thickness; stucco embossed.

4. Foamed-in-Place Insulation: Polyisocyanurate type, ASTM C591 Type IV, CFC and HCFC free; 2.2 to 2.8 pounds per cubic foot density; 95 percent closed cell when tested in accordance with ASTM D6226.

5. Interior Sheet: Galvanized steel, pre-finished, 22 gauge, 0.0299 inch minimum base metal thickness.

6. Panel Edge Profile: Tongue and groove, for flush seam.

7. Fabricate panels in longest practicable lengths.

8. Exterior Finish: Polyvinylidene fluoride (PVDF) coating; color as selected from manufacturer's standard range.

9. Interior Finish: Silicone polyester coating; color as selected from manufacturer's standard range.

2.04 ACCESSORIES

A. Panel Attachment: Stainless steel attachment clips concealed within the panel side joints.

B. Fasteners: Self-drilling, corrosion resistant plated steel with neoprene washers, as recommended by panel manufacturer.

C. Perimeter Trim: Same gauge, material and coating color as exterior face of insulated metal wall panel.

D. Concealed Sealants: Non-curing butyl sealant or tape sealant.

E. Exposed Sealants: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

F. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structural substrate is ready to receive panel system.

3.02 INSTALLATION

A. Install panel system on walls in accordance with manufacturer's instructions.

B. Permanently fasten panel system to structural supports; aligned, level, and plumb, within specified tolerances.

C. Locate panel joints over supports.

D. Use concealed fasteners unless otherwise shown on drawings or approved by Architect.

E. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.03 CLEANING

A. Remove site cuttings from finish surfaces.

3.04 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 53 23 - EPDM THERMOSET SINGLE-PLY ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered roof system with ethylene propylene diene monomer (EPDM) roofing membrane.

B. Insulation, flat and tapered.

C. Vapor retarder.

D. Deck sheathing.

E. Parapet wall sheathing.

F. Roofing stack boots and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Parapet cap flashings and other metal flashings related to roof work.

C. Section 07 71 00 - Roof Specialties: Joint covers at roofs.

D. Section 07 72 00 - Roof Accessories: Manufactured roof curbs, equipment rails, and fall protection anchor posts.

E. Section 07 76 00 - Roof Pavers: Pavers for new paver protection zones.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2016.

E. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015.

F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

G. NRCA (RM) - The NRCA Roofing Manual; 2017.

H. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

I. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's written information listed below.

1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

B. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

E. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this section:

1. With minimum five years documented experience.

2. Approved by membrane manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Protect products in weather protected environment, clear of ground and moisture.

C. Protect foam insulation from direct exposure to sunlight.

D. Keep Safety Data Sheets (SDS) at the project site at all times during transportation, storage, and installation of materials.

E. Comply with requirements from Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather. Refer to manufacturer's written instructions.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 120 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.

F. Do not allow grease, oil, fats, or other contaminants to come into direct contact with membrane.

1.08 WARRANTY

A. System Warranty: Provide manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail in material or workmanship within the specified warranty period. Failure includes roof leaks.

1. Warranty Term: 20 years from date of Substantial Completion.

2. Wind Speed: Warrant system up to wind speed of 100 MPH.

PART 2 PRODUCTS

2.01 ROOFING APPLICATIONS

A. EPDM Membrane Roof System: One ply membrane, fully adhered to cover board over rigid insulation over self-adhered vapor retarder over deck sheathing over existing substrate; components loose-laid, adhered, or mechanically fastened as required by roof system manufacturer and in compliance with the assembly meeting the specified uplift requirements.

B. Single Source Responsibility: To greatest extent practical, provide and install products from a single source.

C. Roofing Assembly Performance Requirements and Design Criteria:

1. Roof Covering External Fire Resistance Classification: Class A when tested per UL 790.

2. Wind Uplift:

a. Designed to withstand wind uplift forces calculated with ASCE 7.

b. Design Wind Speed: As indicated on drawings.

3. Insulation Thermal Resistance (R-Value): Provide R-40 average over entire roof deck.

2.02 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Roofing Membrane:

1. Material: Ethylene propylene diene monomer (EPDM); ASTM D4637/D4637M, Type I (non-reinforced); self-adhering to specified cover board.
2. Thickness: 60 mil, 0.060 inch, minimum.
3. Sheet Width: Factory fabricated into largest sheets possible.
4. Color: Black.
5. **Basis-of-Design Product: Carlisle SynTec Systems; Sure-Seal EPDM SAT (Self-Adhering Technology).**

B. Seaming Materials: As recommended by membrane manufacturer.

C. Vapor Retarder: Composite membrane consisting of 35 mils of rubberized asphalt laminated to 5 mil woven polypropylene film; compatible with roofing and insulation materials; self-adhering to specified deck sheathing.

1. Tensile Strength: 250 PSI, measured in accordance with ASTM D412.
2. Vapor Permeability: 0.015 perm inch, measured in accordance with ASTM E96/E96M.
3. Puncture Resistance: 60 pounds, measured in accordance with ASTM E154.
4. **Basis-of-Design Product: Carlisle SynTec Systems; VapAir Seal 725TR.**

D. Flexible Flashing Material: Same material as membrane.

E. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.03 SHEATHING AND COVER BOARDS

A. Deck Sheathing: Fiberglass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/2 inch thick.

1. Flame Spread and Smoke Developed Index: 0/0 when tested in accordance with ASTM E84.
2. Compressive Strength: 900 PSI, measured in accordance with ASTM C473.
3. **Basis-of-Design Product: Dens-Deck Prime, distributed by Carlisle SynTec Systems.**

B. Parapet Wall Sheathing: Cementitious backer units, ASTM A108.11 and ASTM C1325.

1. Mold Resistance: Score of 10 as rated according to ASTM D3274.
2. Thickness: 1/2 inch minimum.
3. Fasteners: Corrosion-resistant screws for fastening into cold-formed metal framing.

4. **Basis-of-Design Product: USG Durock Brand Cement Board with EdgeGuard.**

C. Cover Board: Polyisocyanurate (ISO) thermal board, complying with ASTM C1289; Type II - Faced with glass facer on one side of core foam, Class 4 with thickness of 1/2 inch, and Grade 1 with 109 psi, maximum, compressive strength.

1. **Basis-of-Design Product: Carlisle SecurShield HD Plus Polyiso.**

2.04 INSULATION

A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578 ; in thicknesses to acheive R-values indicated on the Drawings.

1. Tapered Boards: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.

2. Type and Compressive Resistance: Type II, 15 psi (104 kPa), minimum.

3. Applications:

a. Use at typical new roof assemblies over existing or new metal deck.

b. Use at new roof assembly at PCC1 Skylight.

c. Use at new roof assemby at PCC2 over existing fire-treated plywood deck areas.

B. Polyisocyanurate (ISO) Board Insulation: ASTM C1289, Type II, Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam; Grade 3.

1. Compressive Strength: 20 psi.

2. Applications: Use at new roof assemblies over existing concrete-on-metal-deck.

2.05 ACCESSORIES

A. Compatibility: To greatest extent practical, provide and install accessories from a single source recommended by the roof system manufacturer and roofing installer.

B. Prefabricated Flashing Accessories:

1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.

2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.

3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.

C. Cover board, insulation, fasteners, and deck sheathing adhesives: As recommended by roof system manufacturer and roofing installer.

D. Sealants: As recommended by membrane manufacturer.

E. Walkway Pads: Manufacturer's standard, pre-molded, slip-resistant pads designed to protect the roof membrane in areas exposed to repetitive traffic.

1. Material: Ethylene propylene diene monomer (EPDM); self-adhering or adhered to roofing membrane with manufacturer's recommended adhesive.

2. Size: 30 inches by 30 inches, nominal.

3. Color: Black

F. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

G. Edgings and Terminations: Manufacturer's standard edge and termination accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.

3.02 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.03 DECK SHEATHING INSTALLATION

A. Install deck sheathing on new and existing metal deck, existing concrete-on-metal deck, and existing plywood sheathing over 2x4 sleepers, as indicated on drawings:

1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.

2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.

3. Secure sheathing to roof deck as required by roof system manufacturer and in compliance with the assembly meeting the specified uplift requirements.

3.04 VAPOR RETARDER INSTALLATION

A. Apply self-adhering vapor retarder to deck surface in accordance with manufacturer's instructions.

1. Extend vapor retarder under curbs, and blocking to deck edge.

2. Lap and seal roof vapor retarder over vapor retarder materials of adjacent wall construction.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

3.05 INSULATION AND COVER BOARD APPLICATION

A. Attachment of Insulation - Mechanically Fastened Applications: Loose lay each layer of insulation in accordance with roofing and insulation manufacturer's instructions.

B. Attachment of Insulation - Fully Adhered Applications: Embed each layer of insulation in adhesive in accordance with roofing and insulation manufacturer's instructions.

C. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

D. Attachment of Cover Board: Mechanically fasten and/or embed cover board in adhesive in accordance with roofing and insulation manufacturer's assembly requirements.

E. Install cover board with the proper side down, butting edges of panels together and staggering joints.

F. Do not apply more insulation and cover board than can be waterproofed in the same day.

3.06 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears, and allow to relax in place. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Self-Adhered Application: Install per manufacturer's written installation instructions.

D. Overlap edges and ends and seal seams by contact tape, minimum 3 inches. Seal permanently waterproof.

E. At intersections with vertical surfaces:

1. Extend membrane up a minimum of 6 inches onto vertical surfaces, unless otherwise indicated on the Drawings.

2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. At gravel stops, extend membrane as indicated on drawings.

G. Install roofing expansion joints where indicated, and ensure joints are watertight.

H. Coordinate installation of roof drains and related flashings, locate field splices away from low areas and roof drains, and lap upslope sheet over downslope sheet.

I. Install walkway pads anwhere indicated on drawings in accordance with manufacturer's installation instructions. Space pads to permit water drainage.

J. Daily Seal: Install daily seal per manufacturer's instructions at the end of each workday. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.07 CLEANING

A. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, and other flashings not specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section 07 53 00 - Elastomeric Membrane Roofing.

B. Section 07 72 00 - Roof Accessories: Manufactured metal roof curbs.

1.03 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.

B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Samples: Submit two samples 2 by 2 inch in size illustrating metal finish color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.

1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

2. Color: As indicated on drawings.

B. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick; plain finish shop pre-coated with fluoropolymer coating.

1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.

2. Color: As indicated on drawings.

C. Stainless Steel: ASTM A666/A666M, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) thick; smooth No. 4 - Brushed finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.03 EXTERIOR FLASHINGS

A. Flashing Panels for Exterior Wall Penetrations: Custom fabricated pre-finished galvanized steel or aluminum, as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

B. Flashings for Parapet Walls: Custom fabricated pre-finished galvanized steel or aluminum, profiles and finishes as indicated on Drawings.

2.04 ACCESSORIES

A. Fasteners: Stainless steel, with soft neoprene washers, unless indicated otherwise on drawings.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; translucent.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Secure flashings in place using concealed fasteners to greatest practical extent.

B. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

END OF SECTION

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SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal and Non-Metal expansion joint covers.

1.02 RELATED REQUIREMENTS

A. Section 07 53 23 - EPDM Thermoset Single-Ply Roofing.

B. Section 07 72 00 - Roof Accessories.

1.03 SUBMITTALS

A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

C. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.04 COORDINATION

A. Coordinate installation of roof joint cover assemblies with existing exterior wall joint cover assemblies to ensure that transitions are weathertight.

B. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Expansion Joint Covers:

1. **Basis-of-Design: Construction Specialties, Inc: www.c-sgroup.com.**

2. EMSEAL Joint Systems, Ltd: www.emseal.com.

3. Metal-Era Inc: www.metalera.com.

4. Other manufacturer approved by Owner and Architect.

2.02 COMPONENTS

A. Non-Metal Expansion Joint Covers: Joint cover comprised of composite EPDM flashing to match roof membrane with closed cell urethane foam backing.

1. EPDM Flashing: 60 mils thick, black.

2. Foam backing: Round foam backer rod 1.5 times the diameter of the joint width.

3. Fire-Resistance: Provide joint system with fire barrier with fire-resistance rating as indicated on drawings.

4. Joint Sizes: Field verify.

B. Metal Expansion Joint Covers: Joint cover comprised of continuous rails fastened to continuous cleat and covered with self-centering metal cap attached to turn bar.

1. Exposed Metal Cap: Aluminum sheet, 0.090 inch thick, mill finish.

2. Gasketing: Durometer - 80 Shore A, ASTM D2000.

3. Turnbar: C1075 blue temper spring steel.

4. Integral vapor barrier: 7-ply laminate reinforced polyethylene.

5. Fasteners: As indicated on drawings.

6. Accessories: Factory-fabricated end caps, transitions and miters assembled to be weather-tight.

7. Joint Filler: Batt insulation as specified in Section 07 21 00.

8. Fire-Resistance: Provide joint system with fire barrier assembly with fire-resistance rating as indicated on drawings.

9. Joint Sizes: Field verify.

10. Basis-of-Design Joint Covers and Accessories:

a. **Roof-to-Roof Joint Cover: SRJ as manufactured by Construction Specialties, Inc.**

b. **Roof-to-Wall Joint Cover: SRJW as manufactured by Construction Specialties, Inc.**

2.03 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install components in accordance with manufacturer's instructions in longest lengths possible to minimize splice joints.

B. Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

C. Seal joints within components when required by component manufacturer.

D. Anchor components securely.

E. Terminate exposed ends of joint assemblies with factory-fabricated accessories.

F. Seal terminations and transitions of joint assemblies according to manufacturer's installation instructions.

END OF SECTION

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SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof curbs, equipment rails, and pedestals.

B. Roof travel restraint system with anchor posts, cables and accessories.

C. Snow guards.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking.

B. Section 07 41 13 - Metal Roof Panels: Metal panels to receive snow guards.

C. Section 07 53 23 - EPDM Thermoset Single-Ply Roofing: Roof assembly components

D. Section 07 76 00 - Roof Pavers.

E. Division 23 Heating, Ventilating, and Air-Conditioning: Mechanical equipment supported by manufactured curbs and equipment rails.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

1.04 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

4. Maintenance requirements.

B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

1. Submit complete shop drawings for roof travel restraint system indicating component sizes, locations, and attachment details.

C. Calculations: Submit engineering analysis and calculations prepared and stamped by a licensed engineer demonstrating that roof travel restraint system meets the required loads.

D. Maintenance Manual: Submit manual for travel restraint system including maintenance procedures, parts list, operation procedures indicating safe use of the system, test certificates,

product certificate containing manufacturer's serial number, name, and part number for each individual component used in the system.

E. Warranty Documentation:

1. Submit manufacturer warranty.

2. Ensure that forms are completed in Owner's name and registered with manufacturer.

3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.06 DEMONSTRATION AND TRAINING

A. Roof Travel Restraint: Provide complete demonstration of safe use of the system and train Owner's selected personnel in the inspection and use of the system and system components including body harnessess, lanyards, lifelines, cable trolleys and other critical components.

1. Provide a minimum of one hour of training at the project site using the installed system.

PART 2 PRODUCTS

2.01 CURBS, EQUIPMENT RAILS, AND OTHER ROOF MOUNTING ASSEMBLIES

A. Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Insulated sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water, with seismically-rated vibration isolators selected and sized for the specific equipment supported by the curb.

1. Roof Curb Mounting Substrate: Curb substrate consists of corrugated metal roof deck with insulation, or as otherwise indicated on drawings.

2. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.

3. Fabricate curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.

4. Provide the layouts and configurations indicated on the drawings.

5. Design roof curbs with vibration isolators based on the specific equipment supported and the seismic loads for the project. Roof isolators shall be weather protected with membrane and/or metal flashings.

B. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.

1. Provide preservative treated wood nailers along top of curb.
2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
3. Height Above Finished Roof Surface: 24 inches, minimum, unless indicated otherwise on drawings.

C. Equipment Rails: Two-sided curbs in straight lengths, with top horizontal for equipment mounting.

1. Provide preservative treated wood nailers along top of rails.
2. Height Above Finished Roof Surface: 24 inches, minimum, unless indicated otherwise on drawings.

2.02 ROOF TRAVEL RESTRAINT SYSTEM

A. General: Design and install permanent horizontal lifeline travel restraint system to allow two simultaneous users to walk the entire new roof surface without the ability to travel beyond roof edges and parapet walls. System consists of anchor posts attached to structure through roof assembly; steel cable or wire rope strung between anchor posts; safety flags; and all accessories required for a complete system.

1. **Basis-of-Design System: Flexible Lifeline Systems, Inc.; www.fall-arrest.com.**
2. Other system manufacturers:
   a. Guardian Fall Protection / Guardian Engineered Systems; www.guardianfall.com.
   b. Other manufacturer approved by Architecf

B. Anchor Post: Steel round post with connector top suitable for wire rope, welded to base plate for permanent installation and attachment to structural roof deck; for single point tie-off or used as part of a system.

1. Anchor Post Spacing and Locations: To be determined by system manufacturer as required to meet the design requirements.
2. Steel Finish: Galvanized or factory finish suitable for exposed exterior applications.
3. Loads: Per 29 CFR 1910.140.
4. Post Height: 36 inches.
5. Base Plate: As required to meet the minimum loads specified; to attach to existing roof deck.
6. Base Plate Attachment: As required by system manufacturer.

C. Wire Rope: Stainless steel wire rope strung through and secured to U-ring connectors on anchor posts, with required accessories to provide a complete and continuous secure fall protection system.

1. Diameter: 3/8 inch minimum, and as required to meet minimum loads specified.
2. Minimum Breaking Strength: Per 29 CFR 1910.140.
3. Length: Maximum lengths possible for the system shown on the Drawings.
4. Accessories: As required for attachment and secured to anchor posts.

D. Safety Flags: 4 inch by 5 inch flat, blank, fluorescent orange PVC marking flags on 21 inch steel wire or plastic pipe.

1. Spacing and Locations: Install one flag at each anchor post.

2.03 SNOW GUARDS

A. Non-penetrating Snow Guards: Continuous pipe-type snow guard system; manufacturer's standard dual pipe, bar, channel, or solid rod, set in brackets or posts.

1. Performance Requirements: Provide snow guards to resist design forces as indicated on structural Drawings for roof design snow loads utilizing a factor of safety of 2.0.
2. Brackets: Aluminum.
3. Cross Members: Round, Square, or Octagonal Tube: Aluminum, mill finish.
    a. Outside Diameter, Round: 2 inch, nominal.
    b. Sleeve Couplings: Compatible with tubing and brackets.
    c. End Collars and Caps: Metal to match tube.
4. Clamps for Standing Seam Roof: Non-penetrating Aluminum clamps attached to standing seams of roof panels; for attachment of specified cross members.
    a. Set screws and bolts: 300-series stainless steel, 18-8 alloy.
5. Ice and Snow Clips: 3 inch wide by 1 inch high aluminum.
6. **Basis-of-Design System: X-Gard 2.0 manufactured by S-5!, a division of Metal Roof Innovations, Ltd.; www.s-5.com.**

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

3.04 DEMONSTRATION AND TRAINING

A. Demonstrate and train Owner's personnel in the safe use of the travel restraint system as described paragraph 1.06 of this section.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 07 76 00 - ROOF PAVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof pavers for non-ballasted applications at protection zones shown on Drawings.

1.02 RELATED REQUIREMENTS

A. Section 07 53 23 - EPDM Thermoset Single-Ply Roofing: Substrate for roof pavers.

1.03 SUBMITTALS

A. Product Data: Provide data indicating paver materials.

B. Shop Drawings: Submit shop drawings that indicate paver layout, including overall plan and detail drawings of system components.

C. Warranty Documentation:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

2. Submit documentation from installer that installation complies with warranty conditions for roof overburden.

1.04 WARRANTY

A. Manufacturer Warranty: Provide 2-year manufacturer warranty to replace material that shows manufacturing defects. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 ROOF PAVERS

A. Concrete Roof Pavers for Paver Protection Zones: Precast concrete tiles, with texture and color as indicated; supported by EPDM walkway pads over EPDM roof assembly.

1. Texture and Color: As selected by Architect from manufacturer's standard line.

2. Length and Width: 24 by 24 inches, nominal.

3. Thickness: 2 inches, nominal.

4. Weight: 23 lb, nominal.

2.02 ACCESSORIES

A. Paver Substrate: EPDM walkway pads as specified in Section 07 53 23 - EPDM Thermoset Single-Ply Roofing.

B. Paver Edge Restraints: Provide closure to underside of pavers along perimeter edge of pavers or areas that change elevation or step-down; provide restraint system that fully contain pavers and tie back into building wall or parapet.

1. Metal Edge Termination (at open perimeter pavers): One piece metal edge, J-profile with long leg positioned under pavers and short leg positioned on top of pavers, 0.080 inch aluminum. Secure to roof walkway pads with continuous bead of adhesive.

2. Metal Edge Termination (at parapet walls and curbs): One piece metal securement flashing, angled profile, fastened to parapet walls and/or curbs on top of pavers and providing 2 inch minimum overlap of lower flashing leg over pavers; similar to Carlisle detail PDI 12.2.

C. Paver Adhesive: Roofing installer's recommended bonding adhesive for securing pavers to pavers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive this work.

B. Verify substrate is supported and secure.

C. Verify substrate is clean and smooth, dry and free of snow or ice, flat without depressions, waves or projections, properly sloped and suitable for installation of roof paver system.

D. Verify that roof openings, curbs, and penetrations through roof are solidly set.

E. Verify system elevations and substrate dimensions.

3.02 INSTALLATION

A. Perform work in accordance with manufacturer's written installation instructions and applicable requirements in coordination with project attributes, paver type, pattern, grid layout, starting point, and finished elevation as indicated on approved shop drawings.

B. Install pavers loose-laid on specified substrate and spot bond paver edges with paver adhesive.

1. Provide approximately 1/8 inch space between pavers to permit surface water drainage.

2. Spot bond pavers to adjacent pavers in 4 inch sections at corner intersecction points.

C. Paver Edge Restraints: Install exposed paver edge restraints in accordance with roof paver manufacturer's instructions.

3.03 PROTECTION

A. Protect installed roof pavers from construction operations.

B. Where traffic must continue over finished roof pavers, protect surfaces using durable materials.

3.04 MAINTENANCE

A. Owner of roof paving system must perform routine maintenance of system checking for rocking or loose pavers, broken pavers, and broken or loose edge restraint. Replace broken pavers and edge restraints as needed and re-adhere loose but intact pavers and paver edge restraints as specified in this section.

B. Periodically check that edge restraint is intact and structurally sound.

END OF SECTION

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SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping of all new joints and new penetrations in fire-resistance rated and smoke-resistant assemblies impacted by the work.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015b.

E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013.

F. ITS (DIR) - Directory of Listed Products; current edition.

G. FM (AG) - FM Approval Guide; current edition.

H. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

J. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

K. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:

1. 3M Fire Protection Products: www.3m.com/firestop.

2. Hilti, Inc: www.us.hilti.com.

3. Specified Technologies Inc: www.stifirestop.com.

4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.

5. Or other manufacturer of products meeting the specifications.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

1. Movement: Provide systems that have been tested to show movement capability as indicated.

B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.

1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.

2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

D. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING FOR PERIMETER CONTAINMENT

A. Perimeter Joint Systems That Have Movement Capabilities (Dynamic):

1. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. AS200 Elastomeric Spray.

2. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. Fast Tack Firestop Spray.

3. 2 Hour Construction: UL System CW-D-1011; Specified Technologies Inc. Fast Tack Firestop Spray.

4. 2 Hour Construction: UL System CW-D-2042; Specified Technologies Inc. Fast Tack Firestop Spray.

2.05 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

A. Gypsum Board Walls:

1. Wall to Wall Joints That Have Movement Capabilities (Dynamic):

a. 2 Hour Construction: UL System WW-D-0180; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.

b. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.

2.06 FIRESTOPPING PENETRATIONS THROUGH FRAMED FLOORS

A. Metallic Pipe, Conduit, and Tubing Penetrations in Framed Floors:

1. 1 Hour Construction: UL System F-C-1053; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (for wood frame construction).

2. 1 Hour Construction: UL System F-C-1162; Specified Technologies Inc. Closet Flange Firestop Gasket.

B. Non-Metallic Pipe, Conduit or Tubing in Framed Floors:

1. 1 Hour Construction: UL System F-C-2020; Specified Technologies Inc. LCC Intumescent Firestop Collars.

2. 1 Hour Construction: UL System F-C-2020; Specified Technologies Inc. SSC collars.

3. 1 Hour Construction: UL System F-C-2348; Specified Technologies Inc. RTC range-taking collar.

4. 1 Hour Construction: UL System F-C-2402; Specified Technologies Inc. Closet Flange Firestop Gasket.

2.07 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Penetrations By:

1. Uninsulated Metallic Pipe, Conduit, and Tubing:

a. 2 Hour Construction: UL System W-L-1033; Specified Technologies Inc. SIL silicone sealant.

b. 2 Hour Construction: UL System W-L-1049; Specified Technologies Inc. SSS Intumescent Firestop Sealant.

c. 2 Hour Construction: UL System W-L-1090; Specified Technologies Inc. LC Endothermic Firestop Sealant.

d. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.

e. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.

f. 2 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.

g. 2 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.

h. 2 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.

2. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:

    a. 2 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW wrap strips.

    b. 2 Hour Construction: UL System W-L-2074; Specified Technologies Inc. SSC collars.

    c. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.

    d. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.

3. Insulated Pipes:

    a. 2 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.

    b. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.

    c. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.

    d. 2 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.

    e. 2 Hour Construction: UL System W-L-5273; Specified Technologies Inc. LC Endothermic Firestop Sealant.

2.08 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use any system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Firestopping that is exposed in occupied spaces shall be concealed by metal escutcheons.

C. Install labeling required by code.

D. Install permanent labeling above accessible ceilings with the following information:

1. Fire-resistive rating of the assembly.

2. Approval agency and listing number for firestopping and fire safing system(s) used at penetrations through the fire-resist

3.04 FIELD QUALITY CONTROL

A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 71 00 - Roof Specialties: Sealants used in expansion joint cover assemblies.

B. Section 07 84 00 - Firestopping: Firestopping sealants.

C. Section 08 80 00 - Glazing: Glazing sealants and accessories.

D. Section 23 31 00 - HVAC Ducts and Casings: Duct sealants.

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2014.

B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).

1.04 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.

2. List of backing materials approved for use with the specific product.

3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

4. Substrates the product should not be used on.

B. Color Cards for Selection for Exposed Sealants in Occupied Areas: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.

1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
2. Bostik Inc: www.bostik-us.com.
3. Dow Corning Corporation: www.dowcorning.com/construction/.
4. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
5. Pecora Corporation: www.pecora.com.
6. Sika Corporation: www.usa-sika.com.
7. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    a. Wall expansion and control joints.
    b. Joints between door, window, and other frames and adjacent construction.
    c. Joints between different exposed materials.
    d. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    a. Joints between door, window, and other frames and adjacent construction.

b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.

1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.

c. Other joints indicated below.

3. Do not seal the following types of joints.

a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.

b. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

D. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.

E. Interior Wet Areas: restrooms and mechanical rooms; fixtures in wet areas include plumbing fixtures and other similar items: Use non-staining silicone sealant.

F. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical": Use sealant specifically manufactured for use as "acoustical" or "sound reduction" sealant for gypsum wallboard assemblies; see 09 21 16 - Gypsum Board Assemblies.

2.03 JOINT SEALANTS - GENERAL

A. Colors: As indicated on drawings, or if not indicated then as specified herein, or if not specified then as selected from manufacturer's full range of available colors.

2.04 NONSAG JOINT SEALANTS

A. Use joint sealants specified herein unless indicated otherwise in other sections.

B. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: 100 percent, minimum.

2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.

3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

4. Color: Clear.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 25 percent, minimum.

2. Color: Match adjacent finished surfaces.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

1. Color: To be selected by Architect from manufacturer's full range.

2. Grade: ASTM C834; Grade - Minus 18 Degrees C.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.

2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.

3. Open Cell: 40 to 50 percent larger in diameter than joint width.

4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hollow metal frames for hollow metal doors.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames, where applicable.

D. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing.

C. Section 09 90 00 - Painting and Coating.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2015.

H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

J. ITS (DIR) - Directory of Listed Products; current edition.

K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.

O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

Q. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

R. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements. Shall be submitted concurrently with Door Hardware submittal.

C. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:

1. Ceco Door or Curries, an Assa Abloy Group company: www.assaabloydss.com.
2. Mesker, dormakaba Group; FDJ Series Drywall Frames: www.meskerdoor.com.
3. Steelcraft, an Allegion brand: www.allegion.com.
4. Other manufacturer approved by Architect.

2.02 DESIGN CRITERIA

A. Requirements for Hollow Metal Doors and Frames:

1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements: Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Typical Door Face Sheets: Flush.
4. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being fire-rated must comply with the requirements specified for exterior doors and for fire-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 4 - Maximum-duty.
    b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 2 - Seamless.
    d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
2. Core Material: Vertical steel stiffeners with fiberglass batts.

a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.

3. Door Thermal Resistance: R-Value of 14.

4. Door Thickness: 1-3/4 inch, nominal.

5. Weatherstripping: Refer to Section 08 71 00.

C. Fire-Rated Doors, where indicated on drawings:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 4 - Maximum-duty.

b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 2 - Seamless.

d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").

3. Provide units listed and labeled by UL (DIR) or ITS (DIR).

a. Attach fire rating label to each fire rated unit.

4. Core Material: Manufacturers standard core material/construction in compliance with requirements.

5. Door Thickness: 1-3/4 inch, nominal.

2.04 HOLLOW METAL FRAMES FOR HOLLOW METAL DOORS

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.

1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.

2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.

3. Weatherstripping: Separate, see Section 08 71 00.

D. Interior Door Frames, Non-Fire Rated: Knock-down type or Full profile/continuously welded type.

1. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.

E. Door Frames, Fire-Rated: Knock-down type o Full profile/continuously welded type.

1. Fire Rating: Same as door, labeled.

2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.

F. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 HOLLOW METAL FRAMES FOR WOOD DOORS

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Interior Door Frames, Non-Fire Rated: 18 gage hot dipped galvanized steel; manufacturer's standard unequal rabbet profile with kerf for door seal/gasket; factory finished.

C. Casings: Aluminum, no reveal casing with 1-3/4 inch by 0.375 inch deep face profile; factory finished.

D. Factory Finish: Polyurethane baked enamel; Color/finish as selected by Architect from manufacturer's full range of available colors and finishes. Design intent is to match existing interior frame finish.

E. **Basis-of-Design: Timely CK Series Kerfed Frame with TA-28 Casing.**

2.06 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.07 ACCESSORIES

A. Glazing for Borrowed Lites: Safety glazing, As specified in Section 08 80 00.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered corners; prepared for countersink style tamper proof screws.

C. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.

1. UL listed products in compliance with requirements of authorities having jurisdiction.

2. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.

3. Material: Aluminum.

D. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 71 00.

E. Comply with glazing installation requirements of Section 08 80 00.

F. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 11 16 - Aluminum Doors and Frames: Aluminum frames for interior wood doors.

B. Section 08 71 00 - Door Hardware.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI A208.1 - American National Standard for Particleboard; 2009.

C. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

I. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

J. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

K. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

C. Samples: Submit two samples of door veneer, 4 inch in size illustrating wood grain, stain color, and sheen.

D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

E. Test Reports: Show compliance with specified requirements for the following:

1. Sound-retardant doors and frames; sealed panel tests are not acceptable.

F. Specimen warranty.

G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

B. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.

2. Provide designated labels on shop drawings as required by certification program.

3. Provide designated labels on installed products as required by certification program.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

A. Interior Doors: Provide manufacturer's warranty for the life of the installation.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:

1. Eggers Industries: www.eggersindustries.com.

2. VT Industries, Inc[<>]: www.vtindustries.com.

3. Other manufacturer of products meeting the specifications.

2.02 DOORS

A. Doors: Refer to drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.

1. Provide solid core doors at each location.

2. Smoke and Draft Control Doors: In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.

3. Wood veneer (WD)facing with factory transparent finish to match existing.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC) or bonded agrifiber core with High Density Fiber (HDF) crossbands, plies and faces as indicated.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Anigre (to match existing), veneer grade in accordance with quality standard indicated, quarter cut, with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

1. Vertical Edges: Same species as face veneer.

2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

1. Provide solid blocks at lock edge for hardware reinforcement.

2. Provide solid blocking for other through-bolted hardware.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

1. Transparent:

a. System - 12, Polyurethane, Water-based.

b. Sheen: Satin.

2.07 ACCESSORIES

A. Hollow Metal Door Frames for Wood Doors: As specified in Section 08 11 13.

B. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

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SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling access door and frame units.

1.02 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; current edition.

B. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Manufacturer's Installation Instructions: Indicate installation requirements.

D. Project Record Documents: Record actual locations and sizes of each access unit.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Locations: As indicated on drawings.

B. Wall-Mounted Units:

1. Panel Material: Steel.

C. Wall-Mounted Units in Wet Areas:

1. Panel Material: Stainless steel.

D. Fire-Rated Wall-Mounted Units:

1. Wall Fire-Rating: As indicated on drawings.

2. Panel Material: Steel.

E. Ceiling-Mounted Units:

1. Panel Material: Steel.

F. Fire-Rated Ceiling-Mounted Units:

1. Ceiling Fire-Rating: As indicated on drawings.

2. Panel Material: Steel.

2.02 WALL AND CEILING MOUNTED UNITS

A. Manufacturers:

1. Cendrex, Inc: www.cendrex.com.

2. Karp Associates, Inc: www.karpinc.com.

3. Milcor, Inc: www.milcorinc.com.

4. Nystrom, Inc: www.nystrom.com/#sle.

5. Or other manufacturer approved by Architect.

B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

1. Style: Exposed frame with door surface flush with frame surface.

2. Door Style: Single thickness with rolled or turned in edges.

3. Heavy Duty Frames: 14 gage, 0.0747 inch, minimum thickness.

4. Heavy Duty Single Steel Sheet Door Panels: 14 gage, 0.0747 inch, minimum thickness.

5. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.

a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.

6. Steel Finish for Dry Locations: Primed for field painted finish.

7. Steel Finish for Wet/Damp Locations including restrooms, boiler rooms, and pump rooms: Stainless steel, No. 4 brushed finish.

8. Door/Panel Size: As indicated on the drawings, or if not indicated on the drawings, as follows:

a. Access doors and panels for valve access by hands and arms only: 12"x12" minimum, 18"x18" preferred.

b. Access doors and panels for entry of maintenance personnel: 24"x30" minimum.

9. Hardware:

a. Hardware for Fire-Rated Units: As required for listing.

b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit, all access door locks in the Project keyed alike.

d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

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SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum windows with perimeter trims, stools, shims, anchors, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Sealing frame to water-resistive barrier installed on adjacent construction.

B. Section 07 92 00 - Joint Sealants: Sealing joints between window frames and adjacent construction.

C. Section 08 80 00 - Glazing: Insulated glazing units for installation in aluminum window frames specified in this section.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2017.

B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

I. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

1.04 SUBMITTALS

A. Product Data: Include component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.

B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, anchorage locations, and installation requirements.

C. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:

1. Evidence of AAMA Certification.

2. Evidence of WDMA Certification.

3. Evidence of CSA Certification.

4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

D. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of AAMA CW-10.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Examine and verify existing aluminum window glass, infill panel, and frame characteristics. Design intent is for new windows to match existing.

B. Do not install sealants when ambient temperature is less than 40 degrees F.

C. Maintain this minimum temperature during and 24 hours after installation of sealants.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. **Basis-of-Design: Kawneer Company Inc.; 1600-UT series: www.kawneer.com**

2.02 ALUMINUM WINDOWS

A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, related flashings, and anchorage and attachment devices.

1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.

2. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

3. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

B. Fixed, Non-Operable Type:

1. Construction: Thermally broken.

2. Glazing: See specification section 08 80 00.

3. Exterior Finish: Class II natural anodized.

4. Interior Finish: Class II natural anodized.

2.03 PERFORMANCE REQUIREMENTS

A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:

1. Performance Class (PC): AW.

2. Performance Grade (PG): Equivalent to or greater than specified design pressure.

B. Design Pressure (DP): In accordance with applicable codes. Refer to Structural Drawings.

C. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.

D. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 15 psf.

E. Air Leakage: 0.1 cfm/sq ft maximum leakage per unit area of outside window frame dimension when tested at 6.24 psf pressure difference in accordance with ASTM E283/E283M.

F. Condensation Resistance Factor of Frame: 77 minimum, measured in accordance with AAMA 1503.

G. Overall Thermal Transmittance (U-value): .25, maximum, including glazing, measured on window sizes required for this project.

2.04 COMPONENTS

A. Extruded AlumiFrames: 2-1/2 inch wide by 6.75 inch deep profile; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of screw fastened type.

B. Mullions: Same profile as frames. Interior face of mullions are flush with interior face of window frames.

C. Fasteners: Stainless steel.

D. Glazing Materials: See Section 08 80 00.

E. Spacers, setting blocks, gaskets, and bond breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with specified sealants, and suitable for system performance.

F. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.05 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

1. Recycled Content: Minimum of 50% pre-consumer and/or post-consumer recycled content.

B. Concealed Steel Items: Profiled to suit mullion sections; galvanized in accordance with ASTM A123/A123M.

2.06 FINISHES

A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31, clear anodic coating not less than 0.4 mil thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings and adjoining water-resistive barrier materials are ready to receive aluminum windows.

3.02 WINDOW INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

D. Install sill.

E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install glass in accordance with requirements of Section 08 80 00.

3.03 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

D. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

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SECTION 08 71 00 - DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. Hardware for wood and hollow metal doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames.

B. Section 08 14 16 - Flush Wood Doors.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.

C. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Comply with Owner's required door hardware product standards.

B. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

1.05 SUBMITTALS

A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

B. Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in the drawings.

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).

2. Conform to DHI (H&S) using door numbers and hardware set numbers as indicated in the Contract Documents.

3. Provide complete description for each door listed.

4. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.

5. Include account of abbreviations and symbols used in schedule.

C. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keying Schedule:

1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

1.06 QUALITY ASSURANCE

A. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Closers: Five years, minimum.

2. Locksets and Cylinders: Three years, minimum.

3. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Door Hardware Schedule on drawings.

2.02 HINGES

A. Hinges: Complying with BHMA A156.1, Grade 1.

1. Self Closing Hinges: Complying with BHMA A156.17.

2. Provide hinges on every swinging door.

3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.

4. Provide ball-bearing hinges at each door with closer.

5. Provide following quantity of butt hinges for each door:

   a. Doors From 60 inches High up to 90 inches High: Three hinges.

   b. Doors 90 inches High up to 120 inches High: Four hinges.

2.03 FLUSH BOLTS

A. Flush Bolts: Complying with BHMA A156.16, Grade 1.

1. Flush Bolt Throw: 3/4 inch, minimum.

2. Provide dustproof floor strike for bolt into floor, except at metal thresholds.

3. Self-Latching Flush Bolts: Automatically latch upon closing of door; manually retracted; located on inactive leaf of pair of doors.

2.04 LOCK CYLINDERS

A. Owner's standard product:

1. **Best; CORMAX: www.bestaccess.com.**

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

1. Provide small format interchangeable core (SFIC) type cylinders, Grade 1, with seven-pin E-keyway core in compliance with BHMA A156.5 at locations indicated.

2. Provide cylinders from same manufacturer as locking device.

3. Provide cams and/or tailpieces as required for locking devices.

2.05 MORTISE LOCKS

A. Owner's standard product:

1. **Best; Best 45H series: www.bestaccess.com.**

B. Mortise Locks: Complying with BHMA A156.13, Grade 1, 1000 Series.

1. Latchbolt Throw: 3/4 inch, minimum.

2. Backset: 2-3/4 inch unless otherwise indicated.

3. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.

a. Finish: To match lock or latch.

2.06 COORDINATORS

A. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.

1. Type: Universal, unless otherwise indicated.

2. Material: Aluminum, unless otherwise indicated.

3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.07 CLOSERS

A. Closers: Complying with BHMA A156.4, Grade 1.

1. Provide door closer on each fire-rated and smoke-rated door.

a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.

2. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

3. At corridor entry doors, mount closer on room side of door.

2.08 KICK PLATES

A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.

1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.09 FLOOR STOPS

A. Floor Stops: Complying with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.

1. Provide floor stops when wall surface is not available for wall stop; be cautious not to create a tripping hazard.

2. Type: Manual hold-open, with dome floor stop.

3. Material: Stainless steel housing with rubber insert.

2.10 WALL STOPS

A. Wall Stops: Complying with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.

1. Provide wall stops to prevent damage to wall surface upon opening door.

2. Type: Bumper, concave, wall stop.

3. Material: Stainless steel housing with rubber insert.

2.11 THRESHOLDS

A. Thresholds: Complying with BHMA A156.21.

1. Provide threshold at interior doors for transition between two different floor types, unless otherwise indicated.

2. Type: Flat surface, 1/2" maximum height; use gasketed, ADA compliant acoustic saddle threshold at sound rated doors.

3. Material: Aluminum.

4. Threshold Surface: Smooth and flat.

5. Field cut threshold to profile of frame and width of door sill for tight fit.

2.12 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Complying with BHMA A156.22.

1. Provide sound-rated gasketing and fully-mortised automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

2.13 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.

1. Single Door: Provide three on strike jamb of frame.

2. Pair of Doors: Provide two on head of frame, one for each door at latch side.

3. Material: Rubber, gray color.

2.14 FINISHES

A. Finishes: 619 Satin Nickel. Provide all door hardware of same finish, unless otherwise indicated.

1. Exceptions:

a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.

b. Aluminum Surface Trim and Gasket Housings: Anodized to match door panel finish, not other hardware, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise on drawings.

1. Mounting heights in compliance with ADA Standards:

D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 ADJUSTING

A. Adjust hardware for smooth operation.

B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 51 13 - Aluminum Windows: Aluminum window frames to receive glazing specified in this section.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

D. ASTM C1036 - Standard Specification for Flat Glass; 2016.

E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.

H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

K. GANA (GM) - GANA Glazing Manual; 2009.

L. GANA (SM) - GANA Sealant Manual; 2008.

M. ITS (DIR) - Directory of Listed Products; current edition.

N. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

O. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

Q. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Field Verification: Field verify existing exterior window glass characteristics prior to product submittal. Design intent is for new exterior windows to match existing.

B. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 WARRANTY

A. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Design Pressure: Calculated in accordance with applicable codes.

2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.

3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.

4. Glass thicknesses listed are minimum.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.

1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.

2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.

3. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.

1. Polyvinyl Butyral (PVB) Interlayer: 0.060 inch thick, minimum.

2.03 INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.

2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.

3. Warm-Edge Spacers: Closed cell polymer foam.

a. Spacer Width: As required for specified insulating glass unit.

b. Spacer Height: 0.27 inch.

c. Spacer Color: Black.

4. Edge Seal:

a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.

b. Color: Black.

5. Purge interpane space with dry air, hermetically sealed.

B. Type GL-1 - Insulating Glass Units: Vision glass, triple glazed.

1. Applications: For use in new exterior windows.

2. Space between lites filled with argon or krypton.

3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.

a. Tint: Gray.

b. Coating: Low-E (passive type), on #2 surface.

4. Middle Lite: Annealed float glass, 3/16 inch thick, minimum.
    a. Tint: Clear
    b. Coating: Low-E (passive type), on #3 surface, or as recommended by glass manufacturer.
5. Inboard Lite: Laminated float glass, 1/4 inch thick, minimum.
    a. Tint: Clear.
6. Total Thickness: 1.75 inch.
7. Thermal Transmittance (U-Value): 0.39, maximum.
8. Solar Heat Gain Coefficient (SHGC): 0.27, maximum.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 INSTALLATION

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

B. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

3.03 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.04 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies at interior wall and ceilings.

B. Non-structural metal framing.

C. Metal channel ceiling framing.

D. Gypsum wallboard and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood backing and blocking.

B. Section 07 21 00 - Thermal Insulation: Batt insulation.

C. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire rated walls.

D. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2017.

G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.

H. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

I. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.

J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

K. GA-216 - Application and Finishing of Gypsum Board; 2016.

L. ICC (IBC) - International Building Code; 2015.

M. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.

1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.

2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/360 at 5 psf.

1. Studs: "C" shaped with flat or formed webs with knurled faces in sizes indicated on Drawings.

2. Runners: U shaped, sized to match studs.

3. Ceiling Channels: C-shaped.

4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.

5. Backing and Strapping: Flat stock in widths indicated on drawings.

B. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

C. Partition Head To Structure Connections: Provide deep leg track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.

D. Non-structural Framing Accessories:

1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.

a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.

E. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

1. CertainTeed Corporation: www.certainteed.com.

2. Georgia-Pacific Gypsum: www.gpgypsum.com.

3. National Gypsum Company: www.nationalgypsum.com.

4. USG Corporation: www.usg.com.

5. Other manufacturers approved by Architect.

B. Gypsum Wallboard (GWB): Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.

2. At ceilings: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M.

3. At Assemblies Indicated to be Moisture-Resistant: Use mold-resistant and moisture-resistant gypsum panels:

a. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

b. Water Absorption: Less than 5 percent of weight in accordance with ASTM C630 and ASTM C1396.

c. Humidified Deflection: Not more than 5/8 inch in accordance with ASTM C473.

4. At Assemblies Indicated to be Fire-Rated: Type X or Type C. Use type required by indicated tested assembly.

a. Ceilings: Use Type C unless indicated otherwise.

b. Walls: Use Type X unless indicated otherwise.

5. Thickness: Match existing thicknesses of adjacent construction; at new assemblies, use the following thicknesses:

a. Vertical Surfaces: 5/8 inch, unless indicated otherwise on drawings.

b. Ceilings: 5/8 inch, unless indicated otherwise on drawings.

c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

2.04 ACCESSORIES

A. Insulation: As specified in Section 07 21 00.

B. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.

1. Rigid Corner Beads: Low profile, for 90 degree outside corners.

2. Edge Trim ("J-Beads"): Low profile, formed j-shaped.

3. Expansion and ControlJoints:

a. Type: V-shaped PVC with tear away fins.

C. Finishing Compound: Surface coat and primer, takes the place of skim coating.

D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Suspended Ceilings and Soffits: Space framing and furring members at 24 inches on center.

1. Laterally brace entire suspension system.

B. Studs: Space studs at 16 inches on center, unless indicated otherwise on Drawings.

C. Extend partition framing as indicated on Drawings:

1. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

2. Partitions Penetrating Ceiling but Not Terminating at Structure: Attach top track to roof deck with diagonal bracing not spaced more than 48 inches on center, alternating orientation of each brace.

3. Partitions Terminating at Underside of Structure: Provide track fastened to bottom of structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to second deflection channel set inside but unattached to top track.

4. Partitions Terminating at Underside of Roof Deck: Provide deep leg track fastened to bottom of roof deck with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to second deflection channel set inside but unattached to top track.

D. Blocking and Backing: Install mechanically fastened steel sheet blocking, or fire retardant treated wood as specified in Section 06 10 00, for support of:

1. Framed openings.

2. Wall and ceiling mounted equipment.

3. As otherwise indicated on drawings

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:

1. Not more than 30 feet apart on all walls and ceilings over 40 feet long in any direction.

2. In all hallways and corridors, vertically aligned with each edge of all door jambs, extending from frame to top of wall.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

END OF SECTION

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for ceiling systems impacted by the Work.

B. Suspended metal grid ceiling system.

C. Acoustical units.

D. Ceiling accessories.

1.02 RELATED REQUIREMENTS

A. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Sprinkler heads in ceiling system.

B. Section 23 37 00 - Air Outlets and Inlets: Air diffusion devices in ceiling.

C. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.

D. Section 28 46 00 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.

C. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2016.

F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2019.

G. CHPS (HPPD) - High Performance Products Database; Current Edition at www.chps.net/.

H. UL (GGG) - GREENGUARD Gold Certified Products; current listings at http://http://productguide.ulenvironment.com/QuickSearch.aspx.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

A. Product Data: Provide data on suspension system components.

B. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustical Units and Suspension Systems: Where new acoustical tiles and suspension systems are required, **design intent is to match existing adjacent ceilings**.

1. Armstrong World Industries, Inc: www.armstrong.com.

2. CertainTeed Corporation: www.certainteed.com.

3. USG: www.usg.com.

4. Or equal.

B. Suspension Systems:

1. Same as for acoustical units.

2.02 PERFORMANCE REQUIREMENTS

A. Design: Where existing ceilings or ceiling system components are impacted by the Work and cannot be salvaged, replace with new ceiling systems to match existing.

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:

1. Local authorities having jurisdiction.

2.03 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

1. VOC Content: Certified as Low Emission by one of the following:

a. Product listing in UL (GGG).

b. Product listing in CHPS (HPPD).

B. Acoustical Tile: Painted mineral fiber,ASTM E1264 Type III, with the following characteristics:

1. Thickness: 3/4 inches.

2. Composition: Water felted.

3. Light Reflectance: .83 percent minimum, determined in accordance with ASTM E1264.

4. NRC Range: .75 to .8, determined in accordance with ASTM E1264.

5. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.

6. Edge: Match existing.

7. Surface Color: Match existing.

2.04 SUSPENSION SYSTEM(S)

A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty, profile to match existing suspension system.

C. Finish: _____.

2.05 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid, sufficient for seismic movement.

1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components.

C. Locate system on room axis according to reflected ceiling plans.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

J. Do not eccentrically load system or induce rotation of runners.

K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

1. Use longest practical lengths.

2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:

1. Cut to fit irregular grid and perimeter edge trim.
2. Make field cut edges of same profile as factory edges.

END OF SECTION

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SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Accessories.

1.02 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2015.

B. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).

C. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.

D. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

1.03 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.05 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Rubber Tile: Homogeneous, color and pattern throughout thickness.

1. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. Size: 18 by 18 inch nominal.
4. Total Thickness: 0.020 inch inch.
5. Texture: Raised circular disk pattern to match stair covering.
6. Color: Match new stair covering color.

2.02 STAIR COVERING

A. One-piece Stair Treads and Risers: Rubber; full width and depth of stair tread in one piece; tapered thickness.

1. Nominal Thickness: 0.250 inch at nose.
2. Nosing: Square, adjusted to 60 degrees.
3. Texture: Raised circular disk pattern.
4. Color: Match existing stair covering color.
5. **Basis-of Design Product: Flexco's Heavy Duty Radial II One-Piece Tread with Riser 1701 & 1776.**

2.03 RESILIENT BASE

A. Resilient Base [RB-1]: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.

1. Height: 4 inch.
2. Thickness: 0.125 inch.
3. Finish: Satin.
4. Length: Roll.

5. Color: To be selected from manufacturer's full range of available colors.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is fully cured.

C. Clean substrate.

3.02 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:

1. Spread only enough adhesive to permit installation of materials before initial set.

2. Fit joints and butt seams tightly.

3. Set flooring in place, press with heavy roller to attain full adhesion.

D. Spread only enough adhesive to permit installation of materials before initial set.

E. Fit joints and butt seams tightly.

F. Set flooring in place, press with heavy roller to attain full adhesion.

G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated on Drawings. Omit edge strips where flooring terminates at adjacent flooring of identical thickness.

I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.03 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.05 INSTALLATION - STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread.

B. Adhere over entire surface. Fit accurately and securely.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

1.02 SCOPE

A. Finish all new interior and exterior surfaces exposed to view, unless fully factory-finished.

1. Mechanical and Electrical: match finish of existing mechanical/electrical components.

2. Structural: Paint all structural components exposed to view in finished areas.

B. Do Not Paint or Finish the Following Items:

1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.

2. Items indicated to receive other finishes.

3. Items indicated to remain unfinished.

4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.

5. Floors, unless specifically so indicated.

6. Ceramic and other tiles.

7. Glass.

8. Concealed pipes, ducts, and conduits.

1.03 REFERENCE STANDARDS

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

1.04 SUBMITTALS

A. Product Data: Provide complete list of all products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").

B. Samples: Submit two paper "draw down" samples, 8.5 by 11 inches in size, illustrating each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

C. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.

D. Manufacturer's Instructions: Indicate special surface preparation instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint: Store in ventilated area with ambient temperature within manufacturer's required range.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products from the same manufacturer unless otherwise permitted by Architect.

B. **Paint Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com**.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.

1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each coating material in quantity required to complete entire project's work from a single production run.

3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:

1. Provide coatings that comply with the most stringent requirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Colors: Match existing paint colors.

2.03 PAINT SYSTEMS

A. All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated including gypsum board, concrete, wood, and aluminum - 3 Coat:

1. Two top coats and one coat primer.

2. Eggshell: MPI gloss level 3; use this sheen unless otherwise

3. Top Coat Product(s):

a. **Sherwin-Williams ProMar 200 Zero VOC Interior Latex.**

4. Primer(s): As recommended by manufacturer of top coats.

B. Door/Trim/Frames/ And for surfaces subject to frequent contact by occupants, including metal and wood - 3 Coat:

1. Applications include non-factory finished hollow metal doors and frames, and interior hollow metal window frames.

2. Two top coats and one coat primer.

3. Semi-Gloss: MPI gloss level 5; use this sheen unless otherwise indicated on drawings.

4. Top Coat Product(s):

a. **Sherwin-Williams ProClassic Waterbased Acrylic-Alkyd.**

5. Primer(s): As recommended by manufacturer of top coats.

C. Concrete Floors Indicated to receive "Epoxy Paint" - 3 Coat:

1. Two top coats and one primer coat

2. Top Coat Product(s):

    a. **Sherwin-Williams ArmorSeal HS Polyurethane Floor Enamel with ArmorSeal 1000HS Epoxy Floor Enamel** as primer.

D. Ferrous Metals, Primed or Unprimed, Latex - 3 Coat:

1. Two top coats and one primer coat.

2. Semi-gloss: MPI gloss level 3: use this sheen unless specified otherwise.

3. Top Coat Product(s):

    a. **Sherwin Williams ProClassic Waterbased Acrylic-Alkyd.**

4. Primer(s): As recommended by manufacturer of top coats.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

H. Concrete Floors and Traffic Surfaces to be Painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

J. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

K. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

L. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

M. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

N. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's instructions.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Sand wood surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Safety and informational signs.

B. Warning Tape.

1.02 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

1.03 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. Signs shall be manufactured in accordance with the requirements of University of Alaska Anchorage Interior Sign Guide, 12/28/2021 edition. Request copy of sign guide from Owner prior to submittal preparation.

2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.

3. Submit for approval by Owner through Architect prior to fabrication.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Signs shall be manufactured in accordance with the requirements of University of Alaska Anchorage Interior Sign Guide, 12/28/2021 edition. Request copy of sign guide from Owner prior to submittal preparation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Store tape adhesive at normal room temperature.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

A. Roof Assembly Signs: Provide a typewritten laser-etched flat aluminum sign inside the building adjacent to all roof access points, as directed by Owner (anticipated quantity: 3). Signs shall contain the following information:

1. Facility name.
2. Contract number.
3. Approximate roof area in square feet.
4. Roof assembly description including deck type, membrane type, membrane thickness, method of application, manufacturer, insulation and cover board system and thickness, presence of tapered insulation for primary drainage, and presense of vapor retarder.
5. Date of completion
6. Installing contractor's identification and contact information.
7. Membrane manufacturer warranty expiration and warranty reference number.
8. Membrane manufacturer warranty contact information.

B. Warning Tape: Provide yellow and black striped warning tape at edges of roof openings as indicated on drawings.

2.02 SIGN TYPES

A. Flat Aluminum Signs: Aluminum sheet per ASTM B209 (ASTM B209M), 5052 alloy, H38 or H36 temper, 0.063 inch, with applied colored coating as indicated.

1. Size: 8 inches by 10 inches.
2. Corners: Rounded.
3. Mounting: Mount to door or wall as directed by Owner with exposed stainless steel fasteners or double-sided tape.
4. Background Color: White
5. Text and Typeface:
    a. Character Font: Helvetica, Arial, or other sans serif font.
    b. Character Color: Contrast with background color.
6. Protective Coating: Manufacturer's standard clear coating.

B. Striped Warning Tape: Self-adhering vinyl roll.

1. Material: Vinyl
2. Width: 3 inches.
3. Thickness: 5 mil.
4. Colors: Yellow and black.
5. Adhesive: Rubber, or manufacturer's standard adhesive for applying vinyl to metal in an exterior application.
6. **Product: 3M Hazard Marking Vinyl Tape 766**, or similar.

2.03 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

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SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.03 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Product Data: Provide extinguisher operational features.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:

1. Kidde, a unit of United Technologies Corp: www.kidde.com.
2. Nystrom, Inc: www.nystrom.com/sle.
3. Pyro-Chem, a Tyco Business: www.pyrochem.com.

B. Fire Extinguisher Cabinets and Accessories:

1. JL Industries, Inc: www.jlindustries.com.
2. Larsen's Manufacturing Co: www.larsensmfg.com.
3. Nystrom, Inc: www.nystrom.com/sle.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable building codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.

1. Class: 4A:80B:C type.

2. Size: 10 pound.

3. Finish: Baked polyester powder coat, red color.

4. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.

B. Cabinet Configuration: Semi-recessed and Surface Mounted type. See Drawings for types and locations.

1. Projected Trim for Semi-Recessed type: Returned to wall surface, with 2.5 inch projection, and 1.75 inch wide face.

C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.

D. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

F. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

G. Finish of Cabinet Interior: White colored enamel.

H. Basis-of-Design Products:

1. Semi-Recessed: **Architectural Series SS-2409-6R with Vertical Duo Door and recessed handle, manufactured by Larsen's Manufacturing Company.**

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.

C. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

D. Additional identification signage for cabinets and extinguishers as required by Authority Having Jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install where indicated on drawings and in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 50 inches from finished floor to top of cabinet, unless otherwise indicated on Drawings.

END OF SECTION

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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet Pipe Sprinkler System.

B. System Design, Materials, Installation, and Certification.

C. System Supervision Alarms.

1.02 SCOPE DESCRIPTION

A. Provide revisions to a wet pipe automatic fire sprinkler system, hydraulically calculated to protect the areas of work complete and in operating order. This ire protection system[s] shall be in compliance with the contract documents, applicable codes and standards, as well as the Authority having jurisdiction. Sprinklers shall be installed throughout the project area, utilizing systems compatible with the specific application.

1.03 SPECIAL REQUIREMENTS

A. This fire protection sprinkler project is subject to review by the Factory Mutual Insurance Company, 601 108th Ave. NE, Suite 1400, Bellevue, WA 98004/Tel: (425) 455-5333/Fax: (425) 454-7847, in addition to the review by the Municipality of Anchorage Fire Department.

B. Revise valve supervision and water flow alarms and trouble signal monitoring system if required.

1.04 CODES AND STANDARDS

A. IBC Latest Adopted Edition.

B. NEC Latest Adopted Edition.

C. UPC Latest Adopted Edition.

D. IMC Latest Adopted Edition.

E. IFC Latest Adopted Edition.

F. FM Global Data Sheet 2-0 Installation Guidelines for Automatic Sprinklers.

G. FM Global Data Sheet 2-8 Earthquake Protection for Water-Based Fire Protection Systems.

H. FM Global Data Sheet 3-26 Fire Protection Water Demand for Nonstorage Sprinklered Properties.

I. NFPA 13 Standard for the Installation of Sprinkler Systems, latest adopted edition.

J. NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants, latest adopted edition.

K. ASCE Standard 7, Minimum Design Loads for Buildings and Other Structures, latest adopted edition.

1.05 RELATED WORK

A. Section 09 90 00 - Painting and Coating.

B. Section 22 05 00 - Common Work Results for Plumbing.

C. Section 23 05 00 - Common Work Results for HVAC.

D. Section 26 05 83 - Wiring Connections.

E. Section 28 31 00 - Fire Detection and Alarm.

1.06 REFERENCES

A. AWWA C510 Backflow Prevention Devices reduced pressure type and double check valve type.

B. USC University of Southern California: Foundation for Cross-connection Control and Hydraulic Research.

1.07 QUALITY ASSURANCE

A. Unless otherwise noted, this is substantially a "performance" specification.

B. Minimum qualifications of the contractor/subcontractor shall include the following:

1. Specialist Firm: Company specializing in automatic fire protection/sprinkler systems, possessing a minimum of three years’ experience with systems similar in nature to the type specified herein.

2. Design Certification: Shop drawings shall be prepared by a person with a minimum certification of level II designer, supervised by a Licensed Professional Engineer or a level III or IV Fire Sprinkler Designer, certified by the National Institute For Certification In Engineering Technologies (NICET), in Fire Protection Engineering Technology Automatic Fire Sprinkler System Layout.

3. Equipment and components: Bear the "UL" label or the "FM" approval marking.

4. Maintain a complete stock of replacement parts.

5. Remain on 24 hour call for emergency service.

6. Maintain an office and telephone, with authorized representatives of the Fire Protection Contractor's firm, including the Designated Project Mechanical Sprinkler Supervisor, with a physical presence and address in Alaska.

7. Bids of wholesalers, contractor or any firm whose principal business is not that of manufacturing and/or installing fire protection systems is not acceptable.

1.08 SUBMITTALS

A. Submit under provisions of Division 01.

B. Submit complete and all at one time; partial submittals will not be considered. Submittals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections.

C. Submit contractor's qualifications, proof of 3 years' experience under this contractor's firm name, and references for at least 5 projects in Alaska of similar type, size, and complexity.

D. Submit a copy of designer's NICET certification and resume or Alaska P.E. license number.

E. Submit shop drawings and hydraulic calculations concurrently to the engineer and the City Fire Marshal for review. Submit one set of stamped approved shop drawings and hydraulic calculations to the Architect/Engineer when available from AHJ. Engineer will retain 1 set of "stamped approved" shop drawings. These sets must include the NICET certification or stamp of a licensed professional engineer as described above.

F. Obtain FM Global (Factory Mutual) acceptance of plans for all elements of fixed automatic fire protection prior to fabrication. Design parameters for these installations, based upon proposed occupancy, may be obtained from FM Global prior to system design. Allow minimum 10 business days for FM Global review of submittals. Submit Hard Copy and Electronic Copies of shop drawings, product data, hydraulic calculations and seismic bracing load calculations for the automatic sprinkler system. Submitted to FM Global as follows:

Hard Copy Submittals:

Attn: FM Global - Plan Review

601 - 108th Avenue NE, Suite 1400

Bellevue, WA 98004

Tel. (425) 455-5333

Electronic Submittals:

ENGSanFranciscoPlanReview@fmglobal.com

G. Submit all written reviews and contractor responses to reviews to the Architect/Engineer.

H. Submit product data, and sprinkler head layout revisions in the project areas. Sprinkler head layout shall be reviewed by the Architect/Engineer. All other approvals shall be secured prior to

materials fabrication. Additional sprinklers as required shall be added at no additional cost to the contract.

I. Shop Drawings shall include the following information in compliance with FM Global:

1. Name of Owner, occupant and Building Permit Number.
2. Location, including street address and legal description.
3. Point of compass.
4. Fire Department Connections.
5. All necessary controlling equipment.
6. Location of water source, type, routing, depth of bury and size of supply piping. Identify location and size of city main and whether it is dead-end or circulating loop, and distance to the flow data test hydrant.
7. All distribution system piping and outlets. Include pipe and fitting types.
8. Location, make, model, size, and power requirements of [dry pipe] [pre-action] system air compressor, [low air alarm switch], air maintenance device, alarm pressure switch as well as the holding capacity, in gallons, for the [dry pipe] [pre-action] system.
9. Reflected ceiling plan showing ceiling heights, construction type, proposed location and type of sprinkler heads, and other ceiling devices such as HVAC diffusers, loud speakers, type and location of light fixtures, etc.
10. Interference control between sprinkler system and other trades.
11. Full height cross section.
12. Location of partitions. Identification of full height walls and draft stops.
13. Location and size of unsprinklered concealed spaces.
14. Identification of unheated areas.
15. Water Flow Test Results; include testing agency; time, date and location of test; actual pitot reading at flow hydrant; and equipment used to perform the test.
16. Make, model, Type, orifice, finish and Temperature rating of sprinklers and their respective locations.
17. On systems that are hydraulically calculated, indicate the square footage area protected by each system.
18. Hydraulic node points.
19. Make, model, and size of all fire protection control valves, alarm valves, and check valves.

20. Identify low point drain and inspector test stations.

21. Indicate the type and location of all piping hangers and equipment supports.

22. Indicate the type and location of all seismic bracing and restraint.

23. Make, model, size, and locations of all pipe couplings, fittings and flanges.

24. Make, model, size, power requirement, and location of alarm bells, buzzers, detectors, and/or alarm panels.

25. Provisions for flushing.

26. When the equipment to be installed is an addition or renovation to an existing sprinkler system, enough of the existing system shall be shown on the shop drawings to indicate the total number of sprinklers and the total square foot area protected by the entire system.

27. Name, address and telephone number of the contractor. If design is by a separate firm, include the name address and telephone number of the design facility.

28. Complete legend of all abbreviations and symbols indicated.

29. Complete schedule of all room occupancies.

30. Location of all unit heaters.

31. Location of all structural penetrations.

32. Note the location of all "exposed" piping.

1.09 MAINTENANCE INFORMATION, FRAMED BUILDING PLAN] AND RECORD DRAWINGS

A. Submit under provisions of Division 01.

B. Install one copy of the record hydraulic calculations and shop drawings in a metal sleeve box on the wall near the fire sprinkler riser.

C. The contractor shall maintain current and up-to-date "Record Drawings" of the fire protection system at the job site, in accordance with Division 01. Significant changes in piping due to onsite coordination with other trades will require recalculation to confirm adequate pipe sizing.

1.10 REVIEWS, APPROVALS, AND PERMITS

A. Obtain written review and/or approval of the entire fire protection system design and arrangement from the following authorities:

1. Architect/Engineer.

2. Municipality of Anchorage Fire Marshal.

3. Owner's Insurance Underwriters.

B. Comply with all review comments, revising the system design as required, and resubmitting in a timely manner, so as not to hinder the construction schedule.

C. Obtain and pay for all required permits, inspections, tests, and approvals as required by authorities having jurisdiction.

1.11 WATER FLOW INFORMATION, HYDRAULIC CALCULATIONS, SEISMIC CALCULATIONS

A. [AWWU Network Model Data indicates a static pressure of (? PSI) and a flow of (? GPM) at 20 PSI residual pressure at hydrant # (?) in grid SW(xxxx).]

B. Hydraulic Calculations shall be accomplished in compliance with the procedures established in FM Global Data Sheet 2-0. In addition to FM Global standards, a minimum 15% pressure buffer is required to be designed into the system. Where local authorities require additional buffer, the contractor shall comply with the more demanding requirement. Do not apply the design area reduction allowed by NFPA for quick response sprinklers in the Hydraulic calculations. FM Global does not allow the design area reduction for quick response sprinklers.

C. Hydraulic Calculations accomplished by computer program for submittal shall be accompanied by a complete legend of the abbreviations, nodes, and symbols utilized on the computer readout.

D. Hydraulic Calculations shall clearly identify the following:

1. System type, sprinkler "K" factor, and "C" factor.

2. Pipe and fittings type.

3. Fitting Equivalent Length chart which complies with the "C" factor and pipe type.

4. FM Global Hazard Category, Design Density and size of the Design Remote Area.

5. The Elevation of the "highest" sprinkler.

6. The available water supply and system demand at the point of connection to the water supply, indicated on a logarithmic graph. Include hose demands.

E. Seismic Bracing Calculations shall clearly identify the following:

1. Type, length and size of brace.

2. Angle allowed of brace.

3. Maximum horizontal load of brace.

4. Brace attachment to structure and load rating.

5. Brace attachment to pipe and load rating.

6. Calculated load to be braced.

7. Seismic bracing calculations, a minimum "G" factor of 0.75 should be used in accordance with FM Global Property Loss Prevention Data Sheet 2-8, Earthquake Protection for Water-Based Fire Protection Systems, Section 2.2.1.2.2. as this facility is located in a FM Global 50-year earthquake zone.

1.12 COORDINATION REQUIRED

A. The contractor shall examine the structural, architectural, mechanical, electrical and all other drawings relating to the building and plan his work accordingly. He shall check and verify all dimensions at the site before fabricating any portion of the system. Any discrepancies in piping and head locations resulting from failure to do so shall be corrected expeditiously to provide proper coordination of all trades.

B. Coordinate work with that of other trades to ensure that adequate space is provided for all work, including requirements for serviceability and accessibility. Locate sprinkler heads to avoid conflict with light fixtures and other installed equipment.

C. Structural penetrations for piping shall be identified and details of those penetrations shall be submitted to the structural engineer for approval, in a timely manner. Structural members which are damaged cut or penetrated without approval shall be replaced at no additional expense to the Owner.

1.13 MATERIALS HANDLING AND STORAGE

A. Deliver, store, protect, and handle products to the site under provisions of Division 01. Deliver and store valves in manufacturer packaging with labeling in place. Prior to installation, piping onsite shall be wrapped with protective wrapping. Valves, piping, materials, and equipment shall be clean and new when system is accepted by the Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide only new materials and equipment, which are standard products of a manufacturer regularly engaged in the manufacture of fire protection equipment.

B. All products shall bear the "UL" label and be FM Approved and listed in the FM Approval Guide, a publication of FM Approvals and be specifically approved for fire protection application where they are used.

2.02 PIPING

A. Wet Pipe Sprinkler Systems:

1. Black steel piping, ASTM A135 schedule 10 or ASTM A795 schedule 40, UL Listed or FM Approved for fire sprinkler service.

2. Piping may be roll-grooved, threaded, flanged, or welded for connection. All threaded pipe shall be schedule 40. No plain-end pipe fitting connections are allowed.

3. CPVC piping is not allowed for use on this project due to Seismic Bracing requirements of FM Global.

2.03 GROOVED FITTINGS, COUPLINGS, AND MECHANICAL TEES

A. Grooved Fittings shall be Victaulic, Gruvlok, or equal. Galvanized fittings shall accompany galvanized piping. Couplings and mechanical tees shall be standard painted Victaulic, Gruvlok, or equal.

B. Slip-Fit fittings and couplings utilized for joining branch piping to new main piping shall not be allowed.

C. Contractor shall follow the manufacturer's suggested methods to prepare, carefully, the ends for these fittings to prevent leakage or system breakdown.

2.04 THREADED PIPE FITTINGS

A. Threaded pipe fitting for this system shall be cast iron 125# ANSI B16.4 or malleable iron 150# ANSI B16.3.

2.05 PIPE FLANGES

A. Pipe flanges for this system shall be Cast Iron Class 125# ANSI B16.5.

2.06 PIPING HANGERS AND SUPPORTS

A. Pipe hangers shall conform to NFPA 13 standards.

2.07 FLEXIBLE SPRINKLER HOSE FITTINGS

A. FM approved and UL listed for use in fire protection service.

B. Seismically qualified for use pursuant to ICC-ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

C. Composition: 100% Type 304 Stainless Steel. 175 or 300 PSI minimum rated pressure as appropriate for installed system.

D. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1 inch true-bore internal corrugated hose diameter.

E. Ceiling bracket of G90 galvanized steel with snap-on clip ends positively attached to the ceiling using tamper-resistant screws. Flexible hose attachment shall be removable hub type with set screw.

2.08 ACCEPTABLE MANUFACTURERS FIRE PROTECTION VALVES AND EQUIPMENT

A. Reliable.

B. Tyco.

C. Potter Electric.

D. Notifier.

E. Victaulic.

F. Potter Roemer.

G. Croker.

H. Viking.

2.09 SPRINKLERS

A. Provide sprinklers as required by FM Global Data Sheets and in compliance with the IBC chapter 9 for the entire project. Sprinkler finish and style as follows:

1. In all areas with surface mounted light fixtures attached to finished suspended ceilings, provide standard spray pendant sprinklers, and extended escutcheons to position the sprinkler deflector below the light fixture. Sprinklers and escutcheons to be chrome finish. Tyco TY-FRB or equal.

2. In all areas with recessed lighting flush to the suspended ceiling finish, provide recessed standard spray pendant sprinklers. Sprinklers and escutcheons to be chrome finish. Tyco TY-FRB or equal.

3. Sprinklers above ceilings and throughout shop and mechanical service areas shall be bronze finish, standard spray, upright or pendant type as required by the drawings.

4. Sidewall sprinklers shall be bronze finish in all service areas, and chrome throughout all public areas.

5. Sprinkler Guards shall be of the same manufacturer and finish as the sprinkler which they are to be installed on. Red guards are acceptable for bronze sprinklers only. Chrome finish guards are required for chrome sprinkler heads.

6. Sprinklers of correct temperature rating shall be installed according to FM Global.

7. Sprinklers for renovations of existing facilities shall match Make, Model, and finish for existing sprinklers, while complying with NFPA 13 standards, provided those sprinklers are still being manufactured.

8. Provide sprinkler wrenches for each type of sprinkler.

PART 3 EXECUTION

3.01 CONTRACTOR COORDINATION

A. The fire protection contractor shall coordinate his work with the work of all other trades to assure timely installation and efficient use of mechanical areas including but not limited to boiler rooms, fan rooms, and ceiling spaces.

B. Any work installed without proper coordination shall be promptly removed and reinstalled in a manner to allow for a good practical arrangement of all items which need to be installed by all crafts involved.

C. In case of coordination dispute, the Architect/Engineer shall be consulted and his decision shall be binding.

D. All costs associated with coordination and arranging or rearranging of the fire protection system shall be borne by the affected contractor, without causing any additional expense to the Owner.

3.02 PIPING INSTALLATION

A. Install piping to conserve building space and route piping around access panels and openings. Piping shall not restrict any access opening.

B. Install low point drain stations in accordance with FM Global standards. Identify the location of drain and test stations with signs on access panels, ceiling panels, or walls adjacent to the station, visible from the floor. Discharge all test pipes and system main drain to outside. Coordinate discharge point with Owner's field representative.

C. Provide seismic protection for the piping system in the project area in accordance with FM Global Data Sheet 2-8 and NFPA 13. Attach bracing to structure with through bolts, washers, and nuts. Provide clearance at all structural penetrations. Provide oversized escutcheon plates or flexible connections where sprinklers penetrate non-frangible ceiling membranes.

D. Piping shall be concealed in all areas with finished ceilings.

E. Piping concealed in walls shall be secured to studs 48" - 60" above the floor.

F. Pipe penetrations through rated fire walls shall be sealed by a "UL" listed system utilizing fire rated caulking. Submit data under paragraph 1.8 (Submittals) of this specification.

G. When piping is supported from manufactured structural members, the Installation of pipe hangers shall comply with truss manufacturer's recommendations for hanger attachments and loading.

H. When pipe hangers are attached to bar joist with wood top and bottom chords, chords shall be predrilled for fasteners, and fasteners shall maintain a minimum distance of 0'-6" from truss "panel points".

I. Pipe hangers shall be "Rod and Ring" type hangers throughout. Piping hangers shall have a minimum of ½" of adjustment on each side of the hanger ring nut, to allow for piping grade adjustment in the future.

J. All "beam clamp" type fasteners shall be installed with retainer straps and locking nuts.

K. All Trapeze members shall be fastened to truss chords or structural members.

L. Installation of all valves and equipment shall comply with manufacturer's suggested installation practices and directions.

M. Provide service access around all equipment.

3.03 SYSTEM TEST

A. Perform main drain test.

B. 48-hour advance notice required for all tests to allow Owner's field representative to witness these tests.

3.04 PAINTING

A. Refer to Division 09.

3.05 PROJECT CLOSEOUT

A. The fire protection contractor shall submit a written affidavit at the completion of the system, stating that the fire protection system as installed complies with all referenced codes and standards, Local Fire Marshal's Office, and the Owner's Insurance Underwriters.

B. Forward one copy of the Contractor's Materials and Test Certificate, FM Global Form 85A and commissioning tests to FM Global for their records upon completion of fire protection installations.

C. Furnish Written Guarantee to the Owner, that materials installations are free from mechanical defects and guaranteeing to replace and repair any and all unsatisfactory and defective work and items, to the satisfaction of the Owner, in a timely manner, for a period of one year after final acceptance of the building by the Owner, and to be responsible for any damage caused to the premises for any such unsatisfactory work.

D. The contractor shall respond within reasonable time, not to exceed 15 days to repair or replace latent or hidden defects at such time as they are discovered.

E. Provide hydraulic placard on system riser if sufficient hydraulic changes were made to the system. Placard shall indicate sprinkler demand and hose demand as separate numbers.

F. Contractor shall fully train the Owner's designated maintenance engineer on the changes made to the fire protection system.

END OF SECTION

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SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 SCOPE

A. All provisions of the Contract including the General and Supplementary Conditions and the General Requirements apply to this work.

1.02 WORK INCLUDED

A. The work to be included in these and all other plumbing subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.

B. Division 01 of the specifications is to be specifically included as well as all related drawings.

1.03 RELATED WORK

A. Related Work Specified Elsewhere:

1. Heating, Ventilating and Air Conditioning (HVAC) Specifications: Division 23.
2. Electrical Specifications: Division 26.
3. Motors and Connections: Division 26.
4. Starters and Disconnects: Division 26.

B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all plumbing equipment motors, motor starters, thermal overload switches, control relays, time clocks, thermostats, motor operated valves, float controls, electric switches, electrical components, wiring and any other miscellaneous Division 22 controls. Disconnect switches are included in the electrical work, unless specifically called out on mechanical plans.

C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.04 REFERENCED CODES - LATEST ADOPTED EDITION

A. NFPA 13 Installation of Sprinkler Systems.

B. NFPA 70 National Electrical Code (NEC).

C. IMC International Mechanical Code.

D. UPC Uniform Plumbing Code.

E. IECC International Energy Conservation Code.

F. IFC International Fire Code.

G. IFGC International Fuel Gas Code.

H. IBC International Building Code.

1.05 PROJECT RECORD DRAWINGS

A. In addition to other requirements of Division 01, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed blind spaces within the building. Show exact dimensions of buried piping off of columns or exterior walls.

B. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.

C. Show the location of all valves and their appropriate tag identification.

D. At completion of project, deliver these drawings to the Architect and obtain a written receipt.

1.06 SUBMITTALS

A. See General Conditions and the General Requirements in Division 01 regarding submittals.

B. Submit by specification section complete and all at one time; partial submittals will not be considered. Submittals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories in order of the Specification Sections. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications.

C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.

D. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.

1.07 OPERATING AND MAINTENANCE MANUALS

A. See General Conditions and the General Requirements in Division 01 regarding Operating and Maintenance Manuals.

B. Submit maintenance manuals to the Engineer covering all equipment, fixtures, devices, etc. installed by the Contractor.

C. The operation and maintenance manuals shall be submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be considered. The Operation and maintenance manuals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories. An index shall be

included with bookmarks and identifying tabs between sections and references to sections of specifications. The manual shall contain, but not limited to, the following types of information:

1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.
2. Catalog cuts of all equipment, fixtures, etc. installed (Marked to identify the specific items used).
3. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
4. Identification numbers of all parts and nearest sources for obtaining parts and services.
5. A copy of valve schedule and reduced scale drawings showing valve locations.
6. Written summary of instructions to Owner.
7. All manufacturers' warranties and guarantees.
8. Contractors Warranty Letter.

D. A periodic maintenance form that includes all of the equipment shall be provided with the maintenance manual. The form shall list each piece of equipment with a list of manufacturers recommended inspection and maintenance tasks, and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done.

1.08 HANDLING

A. See General Conditions and the General Requirements in Division 01 regarding material handling.

B. Deliver packaged materials to job site in unbroken packages with manufacturer's label, and store to facilitate inspection and installation sequence. All items must be labeled and identified as to make, size and quality.

1.09 SUBSTITUTIONS

A. See General Conditions and the General Requirements in Division 01 for substitution request procedures.

B. In accordance with the General Conditions and the General Requirements in Division 01, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment. The Architect/Engineer shall be the final authority regarding acceptability of substitutes.

1.10 DIMENSIONS

A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.

B. Any differences, which may be found, shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

1.11 MANUFACTURER'S DIRECTIONS

A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise. Advise the Architect/Engineer of any such conflicts before installation.

1.12 PERMITS, FEES, ETC.

A. The Contractor under each Division of these specifications shall arrange for a permit from the local authority. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

1.13 TESTING

A. The Contractor under each section shall perform the various tests as specified and required by the Architect, Engineer and as required by applicable code, the State and local authorities. The Contractor shall furnish all labor, fuel and materials necessary for making tests.

1.14 TERMINOLOGY

A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.

B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.

C. The use of the word "shall" conveys a mandatory condition to the contract.

D. "This section" refers to the section in which the statement occurs.

E. "The project" includes all work in progress during the construction period.

F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.15 SCHEDULE OF WORK

A. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process work so as to ensure the proper execution of it.

1.16 COOPERATION AND CLEANING UP

A. The Contractor for the work under each section of the specifications shall coordinate the Contractors work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on the work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.

B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.17 WARRANTY

A. Unless a longer warranty is hereinafter called for, all work, materials and equipment items shall be warrantied for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect/Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer. Warranty shall be in accordance with Division 01.

1.18 COMPLETION REQUIREMENTS

A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.

2. Contractors One Year Warranty.

3. All Manufacturers' Guarantees.

4. Operation and Maintenance Manuals.

1.19 INSPECTION OF SITE - REMODEL PROJECTS

A. The accompanying plans do not indicate completely the existing plumbing and mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work

to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.20 RELOCATION OF EXISTING INSTALLATIONS

A. There are portions of the existing plumbing, mechanical and electrical systems, which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of the Contractors particular trade and that of all other trades. All such existing installations, which interfere with new installations, shall be relocated by the Contractor.

1.21 SALVAGE MATERIALS

A. The Contractor shall remove existing equipment, piping, controls and other items associated with the mechanical systems where no longer required for the project. Where such items are exposed to view or uncovered by any cutting or removal of general construction and has no continuing function (as determined by the Architect/Engineer), they shall be removed.

B. All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the contractor and shall be removed from the site.

PART 2 PRODUCTS

2.01 MATERIALS

A. All equipment shall be regularly cataloged items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications along with any optional items required for proper installation unless otherwise noted. Maintain manufacturer's identification, model number, etc. on all equipment at all times.

B. Where more than one of an item is to be provided, all of the items shall be identical manufacture, make, model, color, etc.

2.02 RESTRICTED MATERIALS

A. No materials containing asbestos in any form shall be allowed.

B. No solder or flux containing lead shall be used on this project.

C. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be "lead free" in accordance with the Safe Drinking Water Act, Section 1417. "Lead free" materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures. All materials

utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.

D. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.03 ELECTRICAL MOTORS

A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.

B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.

C. All motors for use with equipment with variable frequency drives shall be inverter ready motors. Verify compatibility and sizing of motor with variable frequency drive.

D. Size motors for 1.15 service factor and not to exceed 40º C temperature rise above ambient.

E. Fractional horsepower motors to have self-resetting thermal overload switch.

F. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

PART 3 EXECUTION

3.01 DRAWINGS

A. The drawings are partly diagrammatic, not necessarily showing all offsets or exact locations of piping, unless specifically dimensioned. The contractor shall provide all materials and labor necessary for a complete and operable system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see Architectural, Structural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.02 INSTALLATION

A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the IMC, UPC, IBC, NEC, NFPA, IECC, IFGC and IFC Standards; all local and state amendments to all codes and standards.

B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.

C. Compliance with codes and ordinances shall be at the Contractor's expense.

3.03 MEASUREMENTS

A. Verify all measurements on the job site.

B. Locate all equipment and fixtures on the centers of walls, openings, spaces, etc., unless specified otherwise.

C. Check all piping, equipment, etc. to clear openings.

D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with current ADA and ANSI 117.1 standards.

3.04 OPERATING INSTRUCTIONS

A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all systems and equipment under the jurisdiction of the Plumbing Division. These instructions shall also be included in a written summary in the Operating Maintenance Manuals.

B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of eight hours of onsite instruction to the owner designated personnel.

C. When required by individual specification sections provide additional training on plumbing systems and equipment as indicated in the respective specification section.

D. Provide schedule for training activities for review prior to start of training.

3.05 SYSTEM ADJUSTING

A. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all plumbing systems. Test all plumbing equipment, fixtures and piping for proper water distribution, drainage, pressure and flow, adjust systems as required to eliminate splashing, noise and vibration.

3.06 CUTTING, FITTING, REPAIRING, PATCHING AND FINISHING

A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.

B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for piping.

C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.07 PAINTING

A. Perform all of the following painting in accordance with provisions of Division 09 with colors as selected by the Architect. Provide the following items as a part of plumbing work:

1. Factory applied prime and finish coats on plumbing equipment.

2. Factory applied prime coat on access doors.

3. Pipe identification where specified.

B. If factory finish on any equipment furnished is damaged in shipment or during construction, refinish to equal original factory finish.

3.08 INSTALLATION OF EQUIPMENT

A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.

B. Maintain manufacture recommended minimum clearances for access and maintenance.

C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.

D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog. Provide Seismic Restraint in Accordance with Specification Section 22 05 48.

E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.

F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc.

END OF SECTION

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SECTION 22 05 05 - SELECTIVE DEMOLITION FOR PLUMBING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work specified in this Section includes the demolition, removal, and disposition of certain mechanical work.

B. Drawings, the provisions of the Agreement, and Administrative Specification Sections apply to all work of this Section.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect and Owner in writing of conditions detrimental to the proper and timely completion of the work.

B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 DEMOLITION, REMOVAL AND DISPOSITION

A. Saw-cut concrete as shown or required.

B. Piping, Equipment, and Control Wiring to Be Removed: Remove all piping, equipment, and control wiring as indicated. Drawings do not show all existing piping, equipment, and control wiring which is to be removed. Unless indicated otherwise, where existing equipment has been removed, or its use replaced by new equipment, remove connecting piping back to the branch in the main so that there will be no dead ends or unused pipe lines in mechanical spaces at completion.

C. Materials to Owner: All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. The Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the Contractor and shall be removed from the site by the Contractor.

D. Re-use of Materials: Only where indicated on Drawings.

E. Protect any active piping and/or wiring encountered; remove, plug or cap utilities to be abandoned. Notify the Architect and Owner of utilities encountered whose service is not known.

F. Debris Removal: Existing materials removed and not reinstalled or turned over to the Owner shall be immediately removed from the site and disposed of by the Contractor.

G. Repairs: Any portion of the facility damaged, cut back or made inoperable by this Contractor shall be repaired with similar materials as the existing structure and/or damaged item as instructed by the Architect.

END OF SECTION

SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints.

C. Pipe alignment guides.

D. Pipe anchors.

1.02 RELATED SECTIONS

A. Section 22 05 00 - Common Work Results for Plumbing.

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

1.04 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01.

B. Maintenance Data: Include adjustment instructions.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.09 WARRANTY

A. Provide manufacturer's warranty under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Hyspan.

B. Mason Industries.

C. Mercer Rubber Co.

D. Metraflex.

E. Substitutions under provisions of Division 01.

2.02 FLEXIBLE PIPE CONNECTORS

A. Steel Piping:

1. Inner: 321 stainless steel, close pitch, annular corrugated hose.
2. Exterior: 304 stainless steel double braided outer covering.
3. Pressure Rating: 125 psig at 450º F, 200 psig at 70º F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Maximum offset: ¾ inch on each side of installed center line.
7. Connectors shall be Lead Free and UL classified in accordance with ANSI/NSF 61 standard.

B. Copper Piping:

1. Inner Hose: Close pitch, annular corrugated bronze hose.
2. Outer House: Bronze double braided outer covering.
3. Pressure Rating: 125 psig at 450º F, 150 psig at 70º F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Maximum offset: ½ inch on each side of installed center line.
7. Connectors shall be Lead Free and UL classified in accordance with ANSI/NSF 61 standard.

2.03 EXPANSION JOINTS

A. Flexible Expansion Loop (Thermal and Seismic Applications):

1. Flexible loops shall be capable of movement in the ±X, ±Y, and ±Z planes and must completely isolate the equipment from the piping.
2. Flexible expansion/seismic loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis.
3. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug.
4. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application.
5. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.
6. For potable water service, connectors shall be UL classified in accordance with ANSI/NSF 61-1977 standards.
7. Install and guide per manufacturer's recommendations. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.

2.04 ACCESSORIES

A. Pipe Alignment Guides, Spider Type: Primary and intermediate guides shall be of the radial type employing a heavy wall guide cylinder with weld down or bolt down anchor base. A two section guide spider, having 1/8" maximum diametrical clearance with guide cylinder inside diameter, bolted or welded tight to the carrier pipe which slides through the guide cylinder I.D.

Cylinder shall be of sufficient size to clear pipe insulation and long enough to prevent over travel of the spider.

B. Pipe Alignment Guides, Slide Type: Primary and intermediate guides shall be of the sliding type. Two piece construction employing a sliding member to be welded to the carrier pipe and a weld down or bolt down anchor base. Sliding member shall be of sufficient height to clear pipe insulation and long enough to prevent over travel of the slide. Load bearing surfaces shall be Teflon to Teflon (T/T-standard), Teflon to Stainless (T/S), or Graphite to Graphite (G/G) as required for the application.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

E. Provide support and equipment required to control expansion and contraction of piping. Provide pipe offsets or expansion joints where required and/or indicated on drawings.

F. Flexible loops shall be located at, or near the building seismic joint. A vertical support hanger, located within 4 pipe diameters, shall be installed on each side of the flexible loop. Each hanger to be transversely and longitudinally braced per local codes. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of move in the ±X, ±Y, and ±Z planes.

END OF SECTION

SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pressure Gauges and Pressure Gauge Taps.

B. Thermometers and Thermometer Wells.

C. Flow Indicators.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 22 10 00 - Plumbing Piping: Installation of thermometer wells, pressure gauge tappings.

1.03 REFERENCES

A. ASTM E1 - Specification for ASTM Thermometers.

B. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.

C. AWWA C700 - Cold Water Meters - Displacement Type.

D. AWWA C706 - Direct Reading Remote Registration Systems for Cold Water Meters.

1.04 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Include list which indicates use, operating range, total range and location for manufactured components.

C. Submit manufacturer's installation instructions under provisions of Division 01.

1.05 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Division 01.

B. Accurately record actual locations of instrumentation.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trerice.

B. Marsh.

C. Ashcroft.

D. Enerpac.

E. Sisco.

F. Petersen.

G. Weiss.

H. Winters.

I. Substitutions: In accordance with Division 01.

2.02 PRESSURE GAUGES

A. 4½" diameter dial size with a flangeless cast aluminum case, stainless steel friction ring and glass window. Movement will be brass with a bronze bourdon tube and brass socket. Dial face will be white with black figures; pointer will be friction adjustable type. Accuracy will be ±1% of scale range, ASME B40.1 Grade 1A. All wetted parts shall be Lead-Free (PBF) meeting NSF/ANSI Standards 372 and 61.

2.03 PRESSURE GAUGE TAPS

A. Gauge Isolation Valve: Lever handle ball valve, forged brass body, chrome plated brass ball, viton o-rings for maximum 150 psig.

B. Needle Valve: Brass for maximum 150 psig.

2.04 SOLAR DIGITAL THERMOMETERS

A. Hi-impact ABS case; -50/300°F switchable range; 1/2" LCD digits, wide ambient formula display; 1% accuracy; 1/10°F between -19.9/199.9°F resolution; 10 Lux (one foot-candle) LUX rating; 10 second update rate; -30/140°F ambient operating range; Glass passivated thermistor – NTC sensor. Model Digital Vari-angle as manufactured by Weiss Products.

2.05 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required.

2.06 FLOW INDICATORS

A. Double window 316 stainless steel housing, female NPT connections. ABS impeller. Model 300SS by Anderson Midwest or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide needle valve or gauge isolation valve to isolate each gauge.

C. Provide two pressure gauges per pump, installing taps on suction and discharge of pump. Pipe to gauge with isolation valve to each tapping.

D. Thermometers for measuring fluid temperatures shall have stems with insertion lengths of roughly half of the pipe diameter; minimum insertion length will be 2". Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Select bulb length to reach centerline of pipe. Thermometers installed on tanks will have a minimum insertion length of 5".

E. Where insulation thickness exceeds 2", provide a longer stem thermometer with an extension neck, lead free brass (PBF) thermowell. The extension neck shall be at least 2" long.

F. Coat thermometer stem with heat transfer paste prior to installing into the thermowell.

G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale and range selected so that the operating temperature or pressure of the material being measured will fall approximately in the middle of the scale.

I. Install gauges and thermometers in locations where they are easily read from normal operating level.

3.02 PRESSURE GAUGE SCHEDULE

LOCATION	SCALE RANGE
Pumps less than 40' TDH	0 - 30 PSIG
Pumps more than 40' TDH	0 - 60 PSIG
Domestic Water System	0 - 100 PSIG
Others	As applicable

3.03 STEM TYPE THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Domestic Cold water system	0 - 100°F
Domestic Hot Water Supply and Recirc.	0 - 200°F
Others	As applicable

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Piping and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing.

1.02 PRODUCTS FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish hanger and support sleeves for placement into formwork.

1.03 RELATED WORK

A. Division 03 - Cast in Place Concrete: Equipment Bases.

B. Division 07 - Fire Stopping: Joint Seals for Piping Penetration of Fire Rated Assemblies.

C. Division 09 - Painting.

D. Section 22 05 00 - Common Work Results for Plumbing.

E. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.

F. Section 22 05 19 - Meters and Gages for Plumbing Piping.

G. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

H. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

I. Section 22 07 00 - Plumbing Insulation.

J. Section 22 10 00 - Plumbing Piping.

K. Section 22 30 00 - Plumbing Equipment.

L. Section 22 40 00 - Plumbing Fixtures.

1.04 REFERENCES

A. ASME B31.1 - Power Piping.

B. ASME B31.9 - Building Services Piping.

C. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

D. ANSI/MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

E. ANSI/MSS SP69 - Pipe Hangers and Supports - Selection and Application.

F. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of plumbing piping.

1.06 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Provide manufacturers catalog data including load capacity. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

1.07 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handle products under provisions of the Supplementary Conditions.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Acceptable Manufacturers:

1. Anvil.
2. Eaton.
3. Erico.
4. Holdrite.
5. PHD Manufacturing, Inc.

B. Plumbing Piping - DWV:

1. Conform to ANSI/MSS SP58.
2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with neoprene isolation pad.

C. Plumbing Piping - Water:

1. Conform to ANSI/MSS SP58.
2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
8. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
9. Vertical Support: Steel riser clamp.
10. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with neoprene isolation pad.

D. Design hangers to allow installation without disengagement of supported pipe.

E. Copper Plating: All hanger elements in metal-to-metal contact with copper pipe shall have copper plating, hanger rings with factory-applied 1/16 inch minimum thick plastic, or tape cushion strip over all contact surfaces.

F. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gage formed steel channels, 1-5/8 inch square, conforming to ASTM A 570 GR33, one side of channel shall have a continuous slot with inturned lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electro-galvanized.

G. Shield for Insulated Piping 1-½ Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180º segments, minimum 12 inches long at pipe support.

H. Shield for Insulated Piping 2 Inches and Larger: Hard block, calcium silicate insert, 180° segment, 12 inch minimum length, block thickness same as insulation thickness, flame resistant vapor barrier covering and 18 gauge galvanized shield.

I. Shields for Vertical Copper Pipe Risers: Galvanized steel pipe.

2.02 HANGER RODS

A. Steel Hanger Rods: Mild steel, threaded both ends, threaded one end, or continuous threaded. Minimum Hanger Rod Sizes:

PIPE AND TUBE SIZE (INCHES)	ROD SIZE (INCHES)
¼-4	3/8
5-8	1/2
10-12	5/8

2.03 ANCHOR BOLTS

A. Anchor (Expansion) Bolts: Shall be carbon steel to ASTM A 307; nut shall conform to ASTM A194; shall be drilled-in type. Design values for shear and tension shall be not more than 80 percent of the allowable load.

2.04 EQUIPMENT CURBS

A. Fabricate curbs of concrete, unless specifically called out otherwise.

2.05 FLASHING

A. Metal Flashing: 26 gauge minimum galvanized steel.

B. Metal Counter Flashing: 22 gauge minimum galvanized steel.

C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

D. Curb Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.06 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.

C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed caulking.

D. Fire Stopping Insulation: Mineral fiber type, non- combustible.

E. Caulk: Fire stop sealant in compliance with ASTM E814 and UL 1479. Refer to Division 07.

F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.07 FORMED STEEL CHANNEL

A. Manufacturers:

1. Atkore Allied Tube & Conduit Corp.
2. Eaton B-Line Series.
3. PHD Manufacturing, Inc.
4. Subsitutions under provisions of Division 01.

B. Product Description: Galvanized 12 gauge (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install pipe hangers in accordance with ANSI/MSS-SP-69.

3.02 PIPE HANGERS AND SUPPORTS

A. Support plumbing piping in accordance with the latest adopted edition of the UPC.

B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-½ inch minimum vertical adjustment.

E. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

F. Support riser piping independently of connected horizontal piping.

G. Design hangers for pipe movement without disengagement of supported pipe.

H. Provide copper plated hangers and supports for copper piping.

I. Provide guides and anchors in accordance with Specification Section 22 05 16.

J. Provide Seismic restraint in accordance with Specification Section 22 05 48.

3.03 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of where shown on plans and where required by equipment manufacturer installation instructions.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment anchors.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

E. Anchor (Expansion) Bolts: Install anchor bolts for all plumbing piping and equipment as required. Tightly fit and clamp base-supported equipment anchor bolts at all equipment support points. Provide locknuts where piping and equipment is hung. Install anchor (expansion) bolts in holes drilled in concrete where necessary to hang piping or equipment, or to anchor stationary equipment from existing concrete slabs.

3.04 FLASHING

A. Provide flexible flashing and metal counter-flashing where piping penetrates weather or waterproofed walls, floors, and roofs. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash and seal.

B. Flash vent pipes projecting above finished roof surface with pre-manufactured butyl boot.

C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

D. Provide acoustical flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.05 SLEEVES

A. Set sleeves in position in construction. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors one inch above finished floor level. Pack and caulk sleeves full depth and provide floor plate.

D. Where piping penetrates floor, ceiling, or wall, install sleeve, close off space between pipe and adjacent work with fire stopping insulation and caulk seal. Use fire rated caulking where area or occupancy separation walls are penetrated. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

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SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section provides minimum acceptance requirements for vibration isolation and seismic restraints for all plumbing equipment and piping.

1.02 GENERAL

A. The requirements for seismic protection measures to be applied to plumbing equipment and systems specified herein are in addition to any other items called for in other sections of these specifications.

1.03 PLUMBING EQUIPMENT AND PIPING

A. New and existing plumbing equipment shall include the following items to the extent required on plans or in other sections of these specifications.

1. Water Heaters.
2. Expansion Tanks.
3. Pumps with Motors.
4. Domestic Water Piping.
5. Drain, Waste and Vent Piping.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete work is provided in Division 03.

B. Vibration isolation and seismic restraints for heating, fuel and ventilation systems are specified elsewhere in Division 23.

C. Vibration isolation and seismic restraints for electrical systems are provided in Division 26.

1.05 QUALITY ASSURANCE

A. The following codes and standards will apply:

1. International Building Code.
2. American Society of Civil Engineers (ASCE) 7-16.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control restraint products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. The following guides may be used for supplemental information on typical seismic installation practices:

1. Federal Emergency Management Agency (FEMA) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.

2. Sheet Metal and Air-conditioning Contractors' National Association's (SMACNA) Seismic Restraint Manual Guidelines for Mechanical Systems.

3. American Society for Heating, Refrigerating and Air-conditioning Engineers' (ASHRAE) A Practical Guide to Seismic Restraint.

4. Manufacturers Standardization Society of the Valve and Fittings Industry MSS SP-127-2014a, Bracing for Piping Systems, Seismic - Wind - Dynamic, Design, Selection, Application.

1.06 COMPONENT IMPORTANCE FACTOR

A. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor (Ip) on the basis of the following:

Ip = 1.5 Components that contain hazardous or flammable materials.

Ip = 1.0 All other components.

1.07 SUBMITTALS

A. Submit shop drawings and manufacturer's data in accordance with Division 01.

B. Provide calculations for selection of seismic restraints in accordance with IBC and ASCE 7, certified by a qualified professional engineer, licensed in the state of the project.

C. Provide Seismic Restraint plans and calculations for FM Global (Factory Mutual) review. Design parameters for these installations, may be obtained from FM Global prior to system design.

FM Global – Plan Review

601 – 108th Avenue NE, Suite 1400

P.O. Box 96077

Bellevue, WA 98004

Tel. (425) 455-5333

D. Provide Shop drawings along with catalog cuts, templates and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal; and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1. Sway Braces.

2. Seismic Cable Restraint.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Vibration isolators and Seismic Restraint shall be manufactured by:

1. Caddy.

2. Cooper Industries/Eaton.

3. Gripple.

4. International Seismic Application Technology.

5. Kinetics Noise Control.

6. Mason Industries.

7. Vibro-Acoustics by Swegon.

8. VMC Group.

9. Substitutions: Items of same function and performance are acceptable in conformance with Division 01.

2.02 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.

2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.

3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.

4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in installation requirements.

5. The total height of the structure (h) and the height of the system to be restrained within the structure (z) shall be determined in coordination with architectural plans and the General Contractor.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

2.03 SEISMIC BRACING COMPONENTS

A. Steel strut shall be 1-5/8 inch wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.

1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33.

2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33.

3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.

4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS. Gr.33.

5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with seismic restraint device manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.

B. Coordinate locations and sizes of structural supports with locations of seismic restraints.

3.02 SEISMIC RESTRAINTS

A. General:

1. All equipment and piping shall be restrained to resist seismic forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required load by calculations. Additional requirements specified herein are included specifically for this project.

2. Install seismic restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

3. Attachment to structure for suspended equipment and pipe: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.

5. Coordinate sizes and locations of cast-in-place inserts for post-tensioned slabs with seismic restraint manufacturer.

6. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

7. Where rigid restraints are used on equipment or piping, support rods for the equipment or piping at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.

8. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.

B. Concrete Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre- or post-tensioned tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Mechanical Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

C. Equipment Restraints:

1. Seismically restrain equipment as indicated on the schedule. Install fasteners, straps and brackets as required to secure the equipment.

2. Install neoprene grommet washers on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 1/8" (3.2 mm).

3. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Piping Systems:

1. For projects with a Seismic Design Category of D, provide seismic cable restraints on the following:

   a. All piping greater than 3" (75 mm) nominal diameter.

   b. All piping systems assigned a component importance factor, Ip, of 1.5 with a nominal pipe diameter greater than 1" (25 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).

2. "12-inch rule", where pipe can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:

   a. Hangers are detailed to avoid bending of the hangers and their attachment; and provisions are made for piping to accommodate expected deflections. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.

   b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.

3. Restraint spacing:

   a. For ductile piping, space lateral supports a maximum of 40' (12 m) o.c., and longitudinal supports a maximum of 80' (24 m) o.c.

   b. For non-ductile piping (e.g., cast iron, PVC) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.

   c. For piping with hazardous material inside (e.g., natural gas, medical gas) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.

   d. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.

4. Brace a change of direction longer than 12' (3.7 m).

5. Longitudinal restraints for single pipe supports shall be attached directly to the pipe, not to the pipe hanger.

6. For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.

7. Piping on roller supports shall include a second roller support located on top of the pipe at each restraint location to provide vertical restraint.

E. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

F. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.

G. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

H. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.

END OF SECTION

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes identification of plumbing piping and equipment installed under Division 22.

B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.03 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

1.05 QUALITY ASSURANCE

A. Conform to ANSI/ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seton.

B. Marking Services Inc.

C. Craftmark Identification Systems.

D. Substitutions: Under provisions of Division 01.

2.02 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic, minimum 1/16” thick, with engraved black or white letters on contrasting background color. Plate size minimum ¾" X 2-½".

C. Plastic Tags: Laminated three-layer plastic with engraved black or white letters on contrasting background color. Tag size minimum 1-½ inch square.

D. Metal Tags: Brass with stamped letters; tag size minimum 1-½ inch diameter with smooth edges.

E. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed. Larger sizes may have maximum sheet size with spring fastener.

F. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

G. Valve Chart Frame: Aluminum frame with plastic windows.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags using corrosion resistant chain. Number tags consecutively by location.

E. Identify water heaters, pumps, and tanks with plastic nameplates. Identify in-line pumps and other small devices with tags.

F. Identify control panels and major control components outside panels with plastic nameplates.

G. Identify valves in main and branch piping with tags showing service and valve number.

H. Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Locations: Nameplates shall be located so as to be readily visible to maintenance personnel. Motor nameplates shall be readily visible on accessible, three phase motors, otherwise a

duplicate motor nameplate shall be permanently affixed to the driven machinery in a visible locations.

3.03 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule at location as directed by Owner. Chart shall show valve number, service and normal position. Valve numbering shall match facility existing valve numbering scheme. Provide a reduced scale copy of drawings showing valves and valve number. Provide copies of valve chart and drawings for inclusion in operation and maintenance manuals in accordance with Section 22 05 00.

END OF SECTION

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SECTION 22 07 00 - PLUMBING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping Insulation.

B. Equipment Insulation.

C. Jackets and Accessories.

1.02 RELATED WORK

A. Section 22 05 00 - Common Work Results for Plumbing.

B. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.

C. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

D. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

E. Section 22 10 00 - Plumbing Piping.

F. Section 22 30 00 - Plumbing Equipment.

G. Section 22 40 00 - Plumbing Fixtures.

1.03 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.

B. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

D. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

E. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

F. ANSI/ASTM C553 - Mineral Fiber Blanket Thermal Insulation.

G. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

H. ASTM C1136 - Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

I. ASTM D635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

J. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.

K. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

L. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include product description, thermal performance, thickness for each service, and locations.

C. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with three years minimum experience.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723, or ASTM E84.

D. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.06 DELIVERY STORAGE AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Shipment of materials from manufacturer to installation location shall be in weather tight transportation.

D. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.08 FIELD MEASURMENTS

A. Verify field measurements prior to fabrication.

1.09 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Certain-Teed.

B. IMCOA.

C. Johns Manville.

D. Knauf.

E. Substitutions: Under provisions of Division 01.

2.02 INSULATION - PIPING

A. Type A: Glass fiber, rigid, molded, non-combustible insulation; ANSI/ASTM C547; 'k' value of 0.23 at 75º F, rated from 0º F to 850º F, vapor retarder jacket of Kraft paper bonded to aluminum foil, self-sealing lap and butt strips; Johns Manville "Micro-Lok" or approved equal.

2.03 FIELD APPLIED JACKET

A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.

B. PVC Jackets and solvent welding adhesive: One piece, pre-molded type, Johns Manville “Zeston 2000”, fitting covers and jacketing material. Johns Manville “Perma-Weld” solvent welding adhesive.

2.04 INSULATION ACCESSORIES

A. Adhesives: Waterproof and fire-retardant type.

B. Canvas Lagging Adhesive: Fire resistive to ASTM E84 and UL 723.

C. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.

D. Joint Tape: Glass fiber cloth, open mesh.

E. Insulated pipe supports: Calcium silicate with galvanized steel jacket (min. 24 gauge); ANSI/ASTM C533; rigid white; 'k' value of 0.37 at 100º F, rated to 1,200º F; Thermal Pipe Shields “T-2000 Calsil” or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Install materials after piping and equipment has been tested and approved.

B. Clean surfaces for adhesives.

C. Prepare surfaces in accordance with manufacturer's recommendations.

3.02 INSTALLATION - PIPING

A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

B. Continue insulation vapor barrier through penetrations except where prohibited by code.

C. Locate insulation and cover seams in least visible locations.

D. Neatly finish insulation at supports, protrusions, and interruptions.

E. Provide insulated cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Insulate complete system, including under fitting jackets.

F. For insulated pipes conveying fluids above ambient temperature, secure jackets with self-sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions. Insulate complete system, including under fitting jackets.

G. Provide insulated piping supports on piping 1-½" inch diameter or larger. Insulated piping supports shall not be less than the following lengths:

1-½" to 2-½" pipe size	10" long
3" to 6" pipe size	12" long

H. Fully insulate all piping including all spaces under jacketing.

I. Jackets:

1. Indoor, Concealed Applications: Insulated pipes shall have vapor barrier jackets, factory-applied. Vapor barrier PVC fittings may also be used provided joints are sealed with solvent welding adhesive approved by the jacket manufacturer.

2. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 feet above finished floor, finish with PVC jacket and fitting covers or metal jacket.

3.03 SCHEDULE – PIPING

PIPING	TYPE	PIPE SIZE Inch	MINIMUM INSULATION THICKNESS Inch
Domestic Cold Water	A	All Sizes	1”
Domestic Hot Water – Smaller then 1-1/2”	A	All Sizes	1”

PIPING	TYPE	PIPE SIZE Inch	MINIMUM INSULATION THICKNESS Inch
Domestic Hot Water – 1-1/2” and Larger	A	All Sizes	1-1/2”
Domestic Hot Water Recirculated – Smaller then 1-1/2”	A	All Sizes	1”
Rain Leaders	A	All Sizes	1"
Roof Drain Sumps	A	All Sizes	2"
Boiler Feed Water	A	All Sizes	1"
Cold Condensate Drains	A	All Sizes	1"
Vent Through Roof	A	All Sizes	1"
Piping Exposed to Freezing	A	All Sizes	2"

END OF SECTION

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SECTION 22 08 00 - COMMISSIONING OF PLUMBING

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:

1. Domestic hot- and cold-water piping.
2. Sanitary waste and vent piping.
3. Storm drainage piping.
4. Plumbing pumps.
5. Plumbing equipment and controls.
6. Related Requirements:
    a. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
    b. For prefunctional checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

1.03 DEFINITIONS

A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."

B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."

C. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For plumbing testing technician.

B. Prefunctional Checklists: Draft prefunctional checklists will be created by CxA for Contractor review.

C. Prefunctional Checklists: Material, installation, and performance test checklists for systems, assemblies, subsystems, equipment, and components to be part of the Cx process and according to requirements in Section 019113 "General Commissioning Requirements."

D. Facility water distribution piping in areas modified by this project, including the following:

1. Domestic water piping, fittings, and specialties above the roof.
2. Pumps, motors, accessories, and controls.
3. Sleeves and sleeve seals.
4. Meters and gages.
5. General-duty and specialty valves.
6. Hangers and supports.
7. Heat tracing.
8. Vibration isolation[**and seismic restraints**].

E. Domestic water piping in areas modified by this project, including the following:

1. Domestic cold- and hot-water piping, fittings, and specialties inside the building.
2. Pumps, motors, accessories, and controls.
3. Sleeves and sleeve seals.
4. Indoor water-storage tanks.
5. Meters and gages.
6. General-duty and specialty valves.
7. Hangers and supports.
8. Heat tracing.
9. Vibration isolation[**and seismic restraints**].

F. Sanitary waste and vent piping in areas modified by this project, including the following:

1. Gravity and forced-main sewerage piping, fittings, and specialties.
2. Sanitary waste interceptors.
3. Pumps, motors, accessories, and controls.
4. Drains.

5. Sleeves and sleeve seals.
6. Meters and gages.
7. General-duty and specialty valves.
8. Hangers and supports.
9. Heat tracing.
10. Vibration isolation[**and seismic restraints**].

G. Storm-water piping in areas modified by this project, including the following:

1. Drainage piping, fittings, and specialties.
2. Pumps, motors, accessories, and controls.
3. Drains and collection basins.
4. Rainwater collection and storage equipment.
5. Sleeves and sleeve seals.
6. Meters and gages.
7. General-duty and specialty valves.
8. Hangers and supports.
9. Heat tracing.
10. Vibration isolation and seismic restraints.

H. Plumbing fixtures in areas modified by this project, including the following:

1. Water closets, supports and connections, supplies, and flush valves.
2. Urinals, supports and connections, supplies, and flush valves.
3. Lavatories, supports, supplies, drain connections, and faucets.
4. Sinks, supports, supplies, drain connections, and faucets.
5. Tubs, drain connections, and faucets.
6. Showers, supplies, drain connections, and faucets.
7. Wash fountains, supplies, drain connections, and faucets.
8. Emergency plumbing fixtures, supplies, drain connections, and controls.

9. Drinking fountains, supplies, and drainage connections.

I. Test equipment and instrumentation list, identifying the following:

1. Equipment/instrument identification number.

2. Planned Cx application or use.

3. Manufacturer, make, model, and serial number.

4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

J. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

1. Instrument or tool identification number.

2. Equipment schedule designation of equipment for which the instrument or tool is required.

3. Manufacturer, make, model, and serial number.

4. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.05 QUALITY ASSURANCE

A. Plumbing Testing Technician Qualifications:

1. Technicians to perform plumbing prefunctional checklist verification tests, prefunctional checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:

a. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.

b. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.

2. Testing Equipment and Instrumentation Quality and Calibration:

a. Capable of testing and measuring performance within the specified acceptance criteria.

b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.

c. Be maintained in good repair and operating condition throughout duration of use on Project.

d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

3. Proprietary Test Instrumentation and Tools:

    a. Equipment Manufacturer's Proprietary Instrumentation and Tools:

        1) For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:

        2) Be calibrated by manufacturer with current calibration tags permanently affixed.

        3) Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.

        4) Plumbing system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREFUNCTIONAL CHECKLISTS

A. Prepare detailed prefunctional checklists for plumbing systems, assemblies, subsystems, equipment, and components in the area modified by this project.

1. Domestic hot- and cold-water piping.

2. Sanitary waste and vent piping.

3. Storm drainage piping.

4. Plumbing pumps.

5. Plumbing equipment, including the following:

    a. Water softeners.

    b. Water storage tanks.

    c. Water filtration equipment.

    d. Domestic water heating equipment.

    e. Plumbing fixtures.

    f. Water coolers.

3.02 PREFUNCTIONAL CHECKLIST REVIEW

A. Review and provide written comments on draft prefunctional checklists. CxA will create required draft prefunctional checklists and provide them to Contractor.

B. Return draft prefunctional checklist review comments within 10 days of receipt.

C. When review comments have been resolved, the CxA will provide final prefunctional checklists, marked "Approved for Use, (date)."

D. Use only prefunctional checklists, marked "Approved for Use, (date)."

3.03 CX TESTING PREPARATION

A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved submittals.

B. Certify that plumbing systems instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.04 CX TEST CONDITIONS

A. Perform tests using design conditions, whenever possible.

B. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

C. Cx test procedures may direct that set points be altered when simulating conditionsis impractical.

is impractical.

D. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

E. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

F. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.05 CX TESTS COMMON TO PLUMBING

A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.

B. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response according to acceptance criteria.

C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.

D. Comply with prefunctional checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Division 22 Sections specifying plumbing systems and equipment.

E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:

1. Prefunctional checklist verification tests.

2. Prefunctional checklist verification test demonstrations.

3. Cx tests.

4. Cx test demonstrations.

F. Vibration Isolation in Plumbing Systems:

1. Prerequisites: Acceptance of results of prefunctional checklists for vibration and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

   a. Components to Be Tested:

   b. Vibration isolation and seismic control devices in plumbing systems.

   c. Structural systems.

2. Test Purpose: Evaluate effectiveness of vibration isolation and seismic control devices.

3. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness while the isolated equipment operates.

4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness at the following operating conditions:

   a. Maximum speed.

   b. Minimum speed.

   c. Critical speed.

5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.

G. Supervision of Alarms in Plumbing Systems:

1. Prerequisites: Acceptance of results of prefunctional checklists for plumbing systems specified in the Sections listed below:
    a. Section 220500 "Common Results for Plumbing."
2. Scope:
    a. Monitored plumbing system alarms.
3. Purpose:
    a. Verify reporting of monitored plumbing alarm at building management system.
4. Conditions of the Test:
    a. Alarm monitoring systems operating in normal, automatic mode.
    b. Activate monitored plumbing alarms, one at a time.
5. Acceptance Criteria:
    a. Activation of monitored plumbing alarm generates alarm at building management system control panel.
6. Heat Tracing in Plumbing Systems:
    a. Prerequisites: Acceptance of results of prefunctional checklists for heat tracing specified in heat-tracing systems. Comply with requirements listed in Section 220500 "Common Results for Plumbing"
7. Equipment and Systems to Be Tested:
    a. Self-regulating, parallel-resistance heating cables.
    b. Heater trace circuit controller.
8. Test Purpose:
    a. Evaluate response to ambient temperature below freeze-protection set point.
    b. Evaluate heating cable fault alarm.
9. Test Conditions:
    a. Subject temperature sensor to temperature approximately 3 deg F above freeze-protection set point (initial set point 35 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is energized.
    b. Subject temperature sensor to temperature approximately 3 deg F below freeze-protection set point (initial set point 32 deg F). Monitor sensed temperature with a cal-

ibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is de-energized.

c. Simulate an electrical fault on the heating cable.

10. Acceptance Criteria:

a. Freeze-protection circuit is energized at set-point.

b. Freeze-protection circuit is de-energized at set-point temperature plus 3 deg F.

c. Heater trace circuit controller initiates an alarm of cable fault. Alarm is correctly reported at the fire-alarm control panel.

END OF SECTION 22 08 00

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SECTION 22 10 00 - PLUMBING PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Sanitary Sewer Piping.

B. Water Piping.

C. Storm Drain Piping.

D. Valves.

E. Backflow Preventers.

F. Dielectric Connections.

G. Cleanouts.

H. Thermostatic Mixing Valves.

1.02 RELATED WORK

A. Division 02 - Excavating, Backfilling, Trenching.

B. Section 22 05 00 - Common Work Results for Plumbing.

C. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.

D. Section 22 05 19 - Meters and Gages for Plumbing Piping.

E. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

F. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

G. Section 22 07 00 - Plumbing Insulation.

H. Section 22 30 00 - Plumbing Equipment.

I. Section 22 40 00 - Plumbing Fixtures.

1.03 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be “lead free” in accordance with the Safe Drinking Water Act, Section 1417. “Lead free” materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include data on pipe materials, pipe fittings, valves and accessories.

1.05 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves, and components.

B. Disinfection and Test reports: Submit to owner for approval. Include all disinfection and testing reports in O&M manuals.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight. Fittings: Cast iron. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies, Husky Series SD 4000 or approved equal.

2.02 CONDENSATE DRAINAGE

A. PVC Pipe: ASTM D2729. Fittings: PVC. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.03 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy, or ASME B16.22, wrought copper.

2. Joints: ANSI/ASTM B32, solder, Grade 95TA; Flux: ASTM B813 or Press-Fit.

3. Press Fittings: The press fittings connections shall be compatible with seamless K, L or M copper tube made to ASTM B 88. Fittings shall comply with NSF 61, CSA and the UPC. The Fittings shall have a maximum non-shock working pressure of 200 PSI between the temperatures of -20°F and +250°F. Elastomeric seals shall be made of EPDM material. Acceptable manufacturers: Viega ProPress or Nibco Press System.

2.04 STORM DRAIN PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight. Fittings: Cast iron. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies, Husky Series SD 4000 or approved equal.

2.05 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping: 1/16 inch thick preformed neoprene bonded to fiber.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

2.06 ACCEPTABLE MANUFACTURERS - DIELECTRIC CONNECTIONS

A. Elster Perfection - Clearflow.

B. Substitutions: Under provisions of Division 01.

2.07 DIELECTRIC CONNECTIONS

A. Dielectric Connections: Dielectric waterway fitting shall have zinc electroplated steel casing with polypropylene inner lining to provide a dielectric waterway. The fitting shall be designed to meet requirements of ASTM F1545 for continuous use at temperatures up to 225°F and for pressures up to 300 psi. IAPMO, UPC and NSF-61 listed for use with potable water.

2.08 ACCEPTABLE MANUFACTURERS - ALL VALVE TYPES

A. Apollo.

B. FNW.

C. Hammond.

D. Milwaukee.

E. NIBCO.

F. Red-White Valve Corp.

G. Substitutions: Under provisions of Division 01.

2.09 GATE VALVES

A. Not permitted. Use ball valves for isolation service.

2.10 BALL VALVES

A. Up to 2 Inches: 600 PSI CWP Lead free bronze two piece body, full port, forged lead free brass ball, Teflon seats and adjustable packing, lever handle, solder, threaded or press-fit ends.

B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged, solder, threaded or press-fit ends.

2.11 SWING CHECK VALVES

A. Up to 2 Inches: 200 PSI CWP lead free bronze swing with PTFE disc, solder, screwed or press-fit ends.

B. Over 2 Inches: 285 PSI CWP ductile iron body, stainless steel trim, swing disc, renewable disc and seat, flanged ends.

2.12 SPRING LOADED CHECK VALVES

A. Up to 2 inches: 250 PSI CWP Lead free bronze spring loaded with PTFE seat, solder, screwed or press fit ends.

B. Over 2 inches: 200 PSI CWP Cast iron body, bronze trim, spring loaded, renewable composition disc, wafer, flanged ends.

2.13 PRESSURE AND TEMPERATURE RELIEF VALVES

A. Lead free copper silicon alloy body construction, NPT male inlet and NPT female outlet connections, extended thermostat with thermo-bonded coating and test lever. Temperature relief setting of 210 degrees F and pressure relief range of 75 to 100 psi. Watts LF1XL or approved equal.

2.14 BALANCE VALVE

A. NSF 61 compliant lead-free brass body rated for 300 PSIG working pressure, temperature range shall be from -4°F to 250°F, type 304 Stainless Steel ball valve. Valve body shall include two pressure/temperature ports, a drain valve port and a calibrated nameplate with a memory stop. NPT or sweat end connections.

2.15 ACCEPTABLE MANUFACTURERS - BACKFLOW PREVENTERS

A. Watts Regulator.

B. Febco.

C. Colt.

D. Substitutions: Under provisions of Division 01.

2.16 BACKFLOW PREVENTERS

A. General: Backflow preventers shall conform to the applicable requirements of AWWA C510. Furnish a certificate of Full Approval or a current Certificate of Approval for each design, size, and make of backflow preventer being provided for the project. The certificate shall be from the Foundation for Cross- Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size, and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval is not acceptable in lieu of the above. IAPMO (UPC) approved.

B. Combination Boiler Fill Valve and Backflow Preventer: The combination valve shall contain a Boiler Dual Check Valve with Atmospheric Vent and a High Capacity Feed Water Pressure Regulators shall be constructed of an iron and bronze body construction with NPT threaded inlet and outlet connections, a tight seating check valve, purge lever for manual purging, and a stainless steel strainer. Maximum Pressure: 100 psi. Watts Regulator Series 1156F or approved equal.

2.17 ACCEPTABLE MANUFACTURERS - CLEANOUTS

A. J.R. Smith.

B. Zurn.

C. Mifab.

D. Substitutions: Under provisions of Division 01.

2.18 CLEANOUTS

A. Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.19 ACCEPTABLE MANUFACTURERS - MIXING VALVES

A. Cash Acme.

B. Powers.

C. Watts Regulator.

D. Lawler Manufacturing Company.

E. Symmons Industries Inc.

F. Webstone.

G. Substitutions: Under provisions of Division 01.

2.20 MASTER TEMPERING VALVE - ELECTRONIC

A. Lead free digital water temperature control and monitoring system with fully configurable full-color touchscreen interface. System shall control water temperature to ±2°F in accordance with ASSE 1017 and resist “temperature creep” during periods of low/zero demand. The controller shall be password protected and have a user-adjustable outlet temperature range of 60°F to 180°F with high and low temperature alerts and an approach temperature of 2°F. System shall digitally control and monitor mixed outlet temperature. The control shall integrate with building automation systems, not requiring any additional modules or expansion cards to do so, through BACnet and Modbus protocols and feature local and remote temperature alarms. System shall offer the ability to remote temperature control. System shall be capable of sending system alerts by text and/or email and prioritizing alerts based on levels of safety and potential liability. System offers two user levels for security. The control shall be equipped with secure Wi-Fi protocols WPA2-PSK and WPA2- PEAP-MSCHAPv2. System shall feature a user-set, high-temperature sanitization mode for thermal disinfection of bacteria and a programmable temperature set back feature to improve energy efficiency. System shall also feature high speed actuator with override feature. In the event of a power failure, system shall open full cold supply. In case of a loss of cold water, the system shall close hot water supply. System shall be listed/approved to ASSE 1017, cUPC, NSF, UL 60730-1, UL 60730-2-9, IEC 60730, and BTL (BACnet Testing Laboratories).

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

H. Establish invert elevations, slopes for rain leader drainage to 1/4” per foot, minimum. Maintain gradients.

I. Install valves with stems upright or horizontal, not inverted.

J. Provide properly sized handles for valve operation. Handles shall not be cut or bent to make fit where installed.

K. Press Fittings shall be installed in accordance with the manufacturer's installation instructions.

L. Support all piping in accordance with Uniform Plumbing Code and Manufacturer installation instructions. Where there is a conflict between requirements of the Uniform Plumbing Code and Manufacturer installation instructions, the more restrictive requirement shall apply.

3.03 APPLICATION

A. Install unions downstream of valves and at equipment connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Provide spring loaded check valves on discharge of water pumps.

3.04 TESTING

A. Test all water piping in accordance with Section 609 of the UPC. Submit a signed statement with photographic record to the Engineer stating testing dates, procedure and initials of tester. The test pressure for a hydrostatic test shall be 1.5 times the design pressure or 150 psi, whichever is greater, and for an air test shall be 1.1 times the design pressure or 150 psi, whichever is greater.

B. Test all vent piping in accordance with Section 712 of the UPC. Submit a signed statement to the Engineer stating testing dates, procedure and initials of tester.

C. Test all storm drainage piping in accordance with Section 1109 of the UPC. Submit a signed statement to the Engineer stating testing dates, procedure and initials of tester.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush, clean and disinfect the potable water system in accordance with Section 609 of the UPC. Submit a signed statement with test results to the Engineer stating disinfection dates, procedure and initials of tester.

END OF SECTION

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SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Water Heaters.

B. Expansion Tanks.

C. Pumps.

1.02 RELATED WORK

A. Section 22 05 00 - Common Work Results for Plumbing.

B. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.

C. Section 22 05 19 - Meters and Gages for Plumbing Piping.

D. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

E. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

F. Section 22 07 00 - Plumbing Insulation.

G. Section 22 40 00 - Plumbing Fixtures.

1.03 QUALITY ASSURANCE

A. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturers' Association (NEMA).
6. Underwriters Laboratories (UL).

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.04 REGULATORY REQUIREMENTS

A. Conform to NSF, ASME, ETL, and UL requirements for water heaters.

B. Conform to ANSI/ASME Section 8D for manufacture of pressure vessels for heat exchangers.

C. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.

1.05 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

C. Indicate pump type, capacity, materials of construction, power requirements, and affected adjacent construction.

D. Submit manufacturer's installation instructions under provisions of Division 01.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Provide temporary inlet and outlet caps. Maintain caps in Place until installation.

1.08 WARRANTY

A. Provide manufacturer's warranty under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - WATER HEATERS

A. PVI.

B. Substitutions: Under provisions of Division 01.

2.02 COMMERCIAL GAS FIRED WATER HEATER

A. Refer to water heater schedule on mechanical drawings for basis of design water heater model numbers. Provide specified model and accessories or equivalent product from the acceptable manufacturers listed.

2.03 ACCEPTABLE MANUFACTURERS – DOMESTIC WATER THERMAL EXPANSION TANKS

A. Amtrol.

B. Taco.

C. Armstrong.

D. Bell & Gossett.

E. Substitutions: Under provisions of Division 01.

2.04 DOMESTIC WATER THERMAL EXPANSION TANKS

A. Refer to expansion tank schedule on mechanical drawings for basis of design expansion tank model numbers. Provide specified model and accessories or equivalent product from the acceptable manufacturers listed.

2.05 ACCEPTABLE MANUFACTURERS - IN-LINE CIRCULATOR PUMPS

A. Grundfos.

B. Wilo.

C. Taco.

D. Substitutions: Under provisions of Division 01.

2.06 IN-LINE CIRCULATOR PUMPS

A. Refer to pump schedule on mechanical drawings for basis of design pump model numbers. Provide specified model and accessories or equivalent product from the acceptable manufacturers listed.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to NSF AND UL requirements.

B. Coordinate with plumbing piping and related fuel piping, venting, and electrical work to achieve operating system.

C. Pipe relief valves and drains to nearest floor drain or six inches above finished floor.

D. The contractor shall supply all water heaters and flue condensate drains with "P-traps" and unions before the PH neutralizers. All condensate drain piping shall be PVC and supplied/installed by the contractor. All PVC joints shall be glued in place and all barbed fittings shall be secured with tie wraps.

E. The water heaters and flue condensate drains shall not be combined into one neutralizer. All piping shall be per manufactures piping diagrams and directions. PH neutralizers shall be secured to the floor or wall so as not to be exposed to damage or within a normal walkway. The contractor shall fill all "P-traps" and PH neutralizers with tap water before the firing of any water heater.

3.02 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide line sized ball valve and strainer on suction and line sized soft seated check valve and globe valve on discharge.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Roof Drains.

1.02 RELATED WORK

A. Section 22 05 00 - Common Work Results for Plumbing.

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 10 00 - Plumbing Piping.

D. Section 22 30 00 - Plumbing Equipment.

1.03 REFERENCES

A. ANSI A112.21.2 - Roof Drains.

1.04 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

B. Trim: By same manufacturer for each product specified throughout.

1.05 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include sizes, rough-in requirements, service sizes, and finishes.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include fixture trim exploded view and replacement parts lists.

C. Provide Manufacturer's parts list and maintenance information on specialties.

1.07 WARRANTY

A. Provide manufacturer's warranty under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - ROOF DRAINS

A. J.R. Smith.

B. Zurn.

C. Sioux Chief.

D. Mifab.

E. Substitutions: Under provisions of Division 01.

2.02 ROOF DRAINS

A. Refer to plumbing schedules on mechanical drawings for basis of design fixture model numbers. Provide specified model and accessories or equivalent product from the acceptable manufacturers listed.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate forming of roof construction to receive drains to required invert elevations.

3.02 INSPECTION

A. Verify adjacent construction is ready to receive rough-in work of this Section.

3.03 INSTALLATION

A. Install components level and plumb and in accordance with manufacturer’s instructions.

3.04 ADJUSTING AND CLEANING

A. At completion remove all visible stickers and tags not intended to be left in place, thoroughly clean all surfaces of plumbing fixtures.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 SCOPE

A. All provisions of the Contract including the General and Supplementary Conditions and the General Requirements apply to this work.

1.02 WORK INCLUDED

A. The work to be included in these and all other mechanical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.

B. Division 01 of the specifications is to be specifically included as well as all related drawings.

1.03 RELATED WORK

A. Related Work Specified Elsewhere:

1. Plumbing Specifications: Division 22.
2. Electrical Specifications: Division 26.
3. Motors and Connections: Division 26.
4. Starters and Disconnects: Division 26.

B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all mechanical equipment motors, motor starters, thermal overload switches, control relays, time clocks, thermostats, motor operated valves, float controls, damper motors, electric switches, electrical components, wiring and any other miscellaneous Division 23 controls. Disconnect switches are included in the electrical work, unless specifically called out on mechanical plans.

C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.04 REFERENCED CODES - LATEST ADOPTED EDITION

A. NFPA 13 Installation of Sprinkler Systems.

B. NFPA 70 National Electrical Code (NEC).

C. IMC International Mechanical Code.

D. UPC Uniform Plumbing Code.

E. IECC International Energy Conservation Code.

F. IFC International Fire Code.

G. IFGC International Fuel Gas Code.

H. IBC International Building Code.

1.05 PROJECT RECORD DRAWINGS

A. In addition to other requirements of Division 01, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed blind spaces within the building. Show exact dimensions of buried piping off of columns or exterior walls.

B. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.

C. Show the location of all valves and their appropriate tag identification.

D. At completion of project, deliver these drawings to the Architect and obtain a written receipt.

1.06 SUBMITTALS

A. See General Conditions and the General Requirements in Division 01 regarding submittals.

B. Submit by specification section complete and all at one time; partial submittals will not be considered. Submittals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories in order of the Specification Sections. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications.

C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.

D. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.

1.07 OPERATING AND MAINTENANCE MANUALS

A. See General Conditions and the General Requirements in Division 01 regarding Operating and Maintenance Manuals.

B. Submit maintenance manuals to the Engineer covering all equipment, fixtures, devices, etc. installed by the Contractor.

C. The operation and maintenance manuals shall be submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be considered. The Operation and maintenance manuals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections and

references to sections of specifications. The manual shall contain, but not limited to, the following types of information:

1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.
2. Catalog cuts of all equipment, fixtures, etc. installed (Marked to identify the specific items used).
3. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
4. Identification numbers of all parts and nearest sources for obtaining parts and services.
5. Reduced scale drawings of the control system and a verbal description of how these controls operate.
6. A copy of the final test and balance report.
7. A copy of valve schedule and reduced scale drawings showing valve locations.
8. Written summary of instructions to Owner.
9. All manufacturers' warranties and guarantees.
10. Contractors Warranty Letter.

D. A periodic maintenance form that includes all of the equipment shall be provided with the maintenance manual. The form shall list each piece of equipment with a list of manufacturers recommended inspection and maintenance tasks, and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done.

1.08 HANDLING

A. See General Conditions and the General Requirements in Division 01 regarding material handling.

B. Deliver packaged materials to job site in unbroken packages with manufacturer's label, and store to facilitate inspection and installation sequence. All items must be labeled and identified as to make, size and quality.

1.09 SUBSTITUTIONS

A. See General Conditions and the General Requirements in Division 01 for substitution request procedures.

B. In accordance with the General Conditions and the General Requirements in Division 01, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be

compatible with existing equipment. The Architect/Engineer shall be the final authority regarding acceptability of substitutes.

1.10 DIMENSIONS

A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.

B. Any differences, which may be found, shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

1.11 MANUFACTURER'S DIRECTIONS

A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise. Advise the Architect/Engineer of any such conflicts before installation.

1.12 PERMITS, FEES, ETC.

A. The Contractor under each Division of these specifications shall arrange for a permit from the local authority. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

1.13 TESTING

A. The Contractor under each section shall perform the various tests as specified and required by the Architect, Engineer and as required by applicable code, the State and local authorities. The Contractor shall furnish all labor, fuel and materials necessary for making tests.

1.14 TERMINOLOGY

A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.

B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.

C. The use of the word "shall" conveys a mandatory condition to the contract.

D. "This section" refers to the section in which the statement occurs.

E. "The project" includes all work in progress during the construction period.

F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.15 SCHEDULE OF WORK

A. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process work so as to ensure the proper execution of it.

1.16 COOPERATION AND CLEANING UP

A. The Contractor for the work under each section of the specifications shall coordinate the Contractors work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on the work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.

B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.17 WARRANTY

A. Unless a longer warranty is hereinafter called for, all work, materials and equipment items shall be warrantied for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect/Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer. Guarantee shall be in accordance with Division 01.

1.18 COMPLETION REQUIREMENTS

A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.
2. Contractors One Year Warranty.
3. All Manufacturers' Guarantees.
4. Test and Balance Reports.
5. Operation and Maintenance Manuals.

1.19 INSPECTION OF SITE - REMODEL PROJECTS

A. The accompanying plans do not indicate completely the existing plumbing and mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.20 RELOCATION OF EXISTING INSTALLATIONS

A. There are portions of the existing plumbing, mechanical and electrical systems, which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of the Contractors particular trade and that of all other trades. All such existing installations, which interfere with new installations, shall be relocated by the Contractor.

1.21 SALVAGE MATERIALS

A. The Contractor shall remove existing equipment, duct, grilles and other items associated with the mechanical systems where no longer required for the project. Where such items are exposed to view or uncovered by any cutting or removal of general construction and has no continuing function (as determined by the Architect/Engineer), they shall be removed.

B. All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the contractor and shall be removed from the site.

PART 2 PRODUCTS

2.01 MATERIALS

A. All equipment shall be regularly cataloged items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications along with any optional items required for proper installation unless otherwise noted. Maintain manufacturer's identification, model number, etc. on all equipment at all times.

B. Where more than one of an item is to be provided, all of the items shall be identical manufacture, make, model, color, etc.

2.02 RESTRICTED MATERIALS

A. No materials containing asbestos in any form shall be allowed.

B. No solder or flux containing lead shall be used on this project.

C. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.03 ELECTRICAL MOTORS

A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.

B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.

C. All motors for use with equipment with variable frequency drives shall be inverter ready motors. Verify compatibility and sizing of motor with variable frequency drive.

D. Size motors for 1.15 service factor and not to exceed 40º C temperature rise above ambient.

E. Fractional horsepower motors to have self-resetting thermal overload switch.

F. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

PART 3 EXECUTION

3.01 DRAWINGS

A. The drawings are partly diagrammatic, not necessarily showing all offsets or exact locations of piping and ducts, unless specifically dimensioned. The contractor shall provide all materials and labor necessary for a complete and operable system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see Architectural, Structural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.02 INSTALLATION

A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the IMC, UPC, IBC, NFPA, IECC, IFGC and IFC Standards; all local and state amendments to all codes and standards.

B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.

C. Compliance with codes and ordinances shall be at the Contractor's expense.

3.03 MEASUREMENTS

A. Verify all measurements on the job site.

B. Locate all equipment and fixtures on the centers of walls, openings, spaces, etc., unless specified otherwise.

C. Check all piping, ducts, etc. to clear openings.

D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with current ADA and ANSI 117.1 standards.

3.04 OPERATING INSTRUCTIONS

A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all systems and equipment under the jurisdiction of the Mechanical Division. These instructions shall also be included in a written summary in the Operating Maintenance Manuals.

B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of eight hours of on site instruction to the owner designated personnel.

C. When required by individual specification sections provide additional training on HVAC systems and equipment as indicated in the respective specification section.

3.05 SYSTEM ADJUSTING

A. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all controls, proper air distribution, elimination of drafts, noise and vibration.

B. Balance air and water systems for volume quantities shown and as required to ensure even temperature and the elimination of drafts. Balancing shall be done by a qualified firm acceptable to the Engineer. Provide balancing log to the Engineer before substantial completion.

3.06 CUTTING, FITTING, REPAIRING, PATCHING AND FINISHING

A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.

B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for ducts and piping.

C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.07 PAINTING

A. Perform all of the following painting in accordance with provisions of Division 09 with colors as selected by the Architect. Provide the following items as a part of mechanical work:

1. Factory applied prime and finish coats on mechanical equipment.

2. Factory applied prime and finish coat on all air registers, grilles and diffusers, unless otherwise specified.

3. Factory applied prime coat on access doors.

4. Pipe identification where specified.

B. If factory finish on any equipment furnished is damaged in shipment or during construction, refinish to equal original factory finish.

3.08 INSTALLATION OF EQUIPMENT

A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.

B. Maintain manufacture recommended minimum clearances for access and maintenance.

C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.

D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, ductwork, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog. Provide Seismic Restraint in Accordance with Specification Section 23 05 48.

E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.

F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc. Coordinate with general contractor for location and finish. For additional details, see Architectural, Structural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

END OF SECTION

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SECTION 23 05 05 - SELECTIVE DEMOLITION FOR HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

PART 1 GENERAL

1.01 DESCRIPTION

A. Work specified in this Section includes the demolition, removal, and disposition of certain mechanical work.

B. Drawings, the provisions of the Agreement, and Administrative Specification Sections apply to all work of this Section.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.

B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 DEMOLITION, REMOVAL AND DISPOSITION

A. Saw-cut concrete as shown or required.

B. Piping, Ductwork, Equipment, Control Wiring and Tubing To Be Removed: Remove all piping, ductwork, equipment, control wiring and tubing as indicated. Drawings do not show all existing piping, ductwork, equipment, control wiring and tubing which is to be removed. Unless indicated otherwise, where existing equipment has been removed, or its use replaced by new equipment, remove connecting piping and ductwork back to the branch in the main so that there will be no dead ends or unused pipe lines in mechanical spaces at completion.

C. Materials To Owner: All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. The Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the Contractor and shall be removed from the site by the Contractor.

D. Materials To Owner: As indicated on the Drawings.

E. Re-use Of Materials: Only where indicated on Drawings.

F. Protect any active piping and/or wiring encountered; remove, plug or cap utilities to be abandoned. Notify the Architect of utilities encountered whose service is not known.

G. Debris Removal: Existing materials removed and not reinstalled or turned over to the Owner shall be immediately removed from the site and disposed of by the Contractor.

H. Repairs: Any portion of the facility damaged, cut back or made inoperable by this Contractor shall be repaired with similar materials as the existing structure and/or damaged item as instructed by the Architect.

END OF SECTION

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible Pipe Connectors.

B. Expansion Joints.

C. Pipe Alignment Guides.

D. Pipe Anchors.

1.02 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC: Product and installation requirements for vibration isolators used in piping systems.

C. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in hydronic heating and cooling systems.

D. Section 23 23 00 - Refrigerant Piping: Product and installation requirements for piping used in refrigeration systems.

1.03 REFERENCES

A. AMSE B31.1 - Power Piping.

B. ASME B31.5 - Refrigeration Piping.

C. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

D. AWS D1.1 - Structural Welding Code - Steel.

1.04 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

1.05 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01.

B. Maintenance Data: Include adjustment instructions.

1.08 QUALITY ASSURANCE

A. Perform Work in accordance with [ASME B31.1] [ASME B31.5] [ASME B31.9] code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.09 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

A. Provide manufacturer’s warranty under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Hyspan.

B. Mason Industries.

C. Mercer Rubber Co.

D. Metraflex.

E. Substitutions under provisions of Division 01.

2.02 FLEXIBLE PIPE CONNECTORS

A. Steel Piping:

1. Inner Hose: Stainless Steel.
2. Exterior Sleeve: Single braided stainless steel.
3. Pressure Rating: 125 psig WSP and 450º F, 200 psig WOG and 250º F psig at 70º F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Maximum offset: ¾ inch on each side of installed center line.

B. Copper Piping:

1. Inner Hose: Bronze
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 125 psig WSP and 450º F, 200 psig WOG and 250º F and 70º F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units
6. Maximum offset: ¾ inch on each side of installed center line.

2.03 EXPANSION JOINTS

A. Flexible Expansion Loop (Thermal or Seismic Applications):

1. Flexible loops shall be capable of movement in the ±X, ±Y, and ±Z planes and must completely isolate the equipment from the piping.
2. Flexible expansion/seismic loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis.
3. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug.
4. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application.

5. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.

6. Install and guide per manufacturer's recommendations. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.

2.04 ACCESSORIES

A. Pipe Alignment Guide, Spider Type: Primary and intermediate guides shall be of the radial type employing a heavy wall guide cylinder with weld down or bolt down anchor base. A two section guide spider, having 1/8" maximum diametrical clearance with guide cylinder inside diameter, bolted or welded tight to the carrier pipe which slides through the guide cylinder I.D. Cylinder shall be of sufficient size to clear pipe insulation and long enough to prevent over travel of the spider.

B. Pipe Alignment Guide (Slide Type): Primary and intermediate guides shall be of the sliding type. Two piece construction employing a sliding member to be welded to the carrier pipe and a weld down or bolt down anchor base. Sliding member shall be of sufficient height to clear pipe insulation and long enough to prevent over travel of the slide. Load bearing surfaces shall be Teflon to Teflon (T/T-standard), Teflon to Stainless (T/S), or Graphite to Graphite (G/G) as required for the application.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

E. Provide support and equipment required to control expansion and contraction of piping. Provide pipe offsets or expansion joints where required and/or indicated on drawings.

F. Flexible loops shall be located at, or near the building seismic joint. A vertical support hanger, located within 4 pipe diameters, shall be installed on each side of the flexible loop. Each hanger to be transversely and longitudinally braced per local codes. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of move in the ±X, ±Y, and ±Z planes.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pressure Gauges.
2. Pressure Gauge Taps.
3. Thermometers.
4. Electromagnetic Flow Meters.
5. Flow Indicators.

B. PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THE SECTION

1. Section 23 21 13 - Hydronic Piping: Installation of thermometer wells, pressure gauge tappings.
2. Section 23 31 00 - HVAC Ducts and Casings: Installation of thermometers and static pressure gauges.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 09 23 - Direct Digital Control System for HVAC.

C. Section 23 09 93 - Sequence of Operations for HVAC Controls.

D. Section 23 21 16 - Hydronic Piping Specialties.

E. Section 23 33 00 - Air Duct Accessories.

1.03 REFERENCE STANDARDS

A. ASTM E1 - Specification for ASTM Thermometers.

B. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.

C. ASTM E1 - Standard Specification for ASTM Thermometers.

1.04 SUBMITTALS

A. Product Data: Submit engineering data for each component, include list which indicates use, operating range, total range and location for manufactured components.

B. Submit manufacturer's installation instructions under provisions of Division 01.

1.05 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual location of all instrumentation and gauges.

B. Operation and Maintenance Data.

1.06 WARRANTY

A. Provide manufacturer’s warranty under provisions of Division 01.

PART 2 PRODUCTS

2.01 INSTRUMENTATION FOR HVAC

A. Manufacturers:

1. Dwyer
2. Trerice.
3. Weiss.
4. Marshaltown.
5. Ashcroft.
6. Enerpac.
7. Peterson.
8. Winters.
9. Substitutions: In accordance with Division 01.

2.02 PRESSURE GAUGES

A. 4½" diameter dial size with a flangeless cast aluminum case, stainless steel friction ring and glass window. Movement will be brass with a bronze bourdon tube and brass socket. Dial face will be white with black figures; pointer will be friction adjustable type. Accuracy will be ±1% of scale range, ASME B40.1 Grade 1A.

2.03 PRESSURE GAUGE TAPS

A. Gauge Isolation Valve: Lever handle ball valve, forged brass body, chrome plated brass ball, viton o-rings for maximum 150 psig.

B. Needle Valve: Brass for maximum 150 psig.

2.04 STEM TYPE THERMOMETERS

A. Hi-impact ABS case; -50/ 300°F (-45/150° C) swtichable range; 1/2" LCD digits, wide ambient formula display; 1% accuracy; 1/10° between -19.9/199.9 °F (-28/93°C) resolution; 10 Lux (one foot-candle) LUX rating; 10 second update rate; -30/140°F (-35/60°C) ambient operating range; Glass passivated thermistor – NTC sensor. Model Digital Vari-angle as manufactured by Weiss Products.

2.05 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel or Viton core for temperatures up to 350 degrees F.

2.07 ELECTROMAGNETIC FLOW METERS

A. Manufacturers:

1. Onicon.

2. Substitutions: Under provisions of Division 01.

B. Inline electromagnetic flow meter with integral or remote-mounted transmitter and backlit LCD display. Wetted components shall be 316L stainless steel with manufacturer-selected liner suitable for system temperature and pressure. Meter shall provide bidirectional flow measurement with accuracy of ±0.2% of rate over the normal operating range and maintain accuracy with minimal straight-pipe requirements. Minimum fluid conductivity shall be 5 µS/cm. Transmitter shall provide analog and digital outputs and support BACnet MS/TP, Modbus RTU, or Modbus TCP/IP. Power supply shall be 24 VAC/VDC or 120–240 VAC. Meter shall be suitable for chilled water, heating hot water, condenser water, and domestic hot water systems.

C. Pre-calibrated and certified to N.I.S.T. standards.

2.08 FLOW INDICATORS

A. Double tempered glass window with rotating impeller, 316 stainless steel body, female NPT connections, 316 SS impeller. Temperature limit 200 Deg F, Pressure Limit 125 psig. Horizontal or vertical mounting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide needle valve or gauge isolation valve to isolate each gauge.

C. Provide two pressure gauges per pump, installing taps on suction and discharge of pump. Pipe to gauge with isolation valve to each tapping.

D. Thermometers for measuring fluid temperatures shall have stems with insertion lengths of roughly half of the pipe diameter; minimum insertion length will be 2". Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Select bulb length to reach centerline of pipe. Thermometers installed on tanks will have a minimum insertion length of 5".

E. Where insulation thickness exceeds 2", provide a longer stem thermometer with an extension neck, stainless steel separable thermowell. The extension neck shall be at least 2" long.

F. Coat thermometer stem with heat transfer paste prior to installing into the thermowell.

G. Install thermometer sockets and flanges adjacent to controls system thermostat, transmitter, or sensors.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale and range selected so that the operating temperature or pressure of the material being measured will fall approximately in the middle of the scale.

I. Install gauges, electromagnetic flow meters, flow indicators, and thermometers in locations where they are easily read from normal operating level.

J. Thermometers for measuring air temperatures shall have a perforated guard stem and a mounting flange.

K. Install solar thermometers in locations where solar cells are activated by fixed interior lighting.

3.02 PRESSURE GAUGE SCHEDULE

LOCATION	SCALE RANGE
Pumps less than 40' TDH	0 - 30 PSIG
Pumps more than 40' TDH	0 - 60 PSIG
Hyrdronic Heating system	0 - 30 PSIG
Others	As applicable

3.03 THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Hyrdronic Heating system	0 - 200° F
Others	As applicable

3.04 DIAL THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Each supply air zone	0 - 100° F
Outside air	-40 - 120° F
Return air	0 - 100° F
Mixed air	0 - 100° F
Others	As applicable

3.05 STATIC PRESSURE AND FILTER GAUGE SCHEDULE

LOCATION	SCALE RANGE
Filter banks	0 - 1 IN H_2O
Supply fan discharge	0 - 2 IN H_2O
Building static	-0.25 - 0.25 IN H_2O

END OF SECTION

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SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe, Duct, and Equipment Hangers, Supports, and Associated Anchors.

B. Hanger Rods.

C. Inserts.

D. Equipment Curbs.

E. Equipment Bases and Supports.

F. Formed Steel Channel.

G. Sleeves and Seals.

1.02 PRODUCTS FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish hanger and support sleeves for placement into formwork.

B. Placement of equipment roof support curbs.

1.03 RELATED WORK

A. Division 03 - Cast in Place Concrete: Equipment Bases.

B. Division 07 - Fire Stopping: Joint Seals for Piping and Duct Penetration of Fire Rated Assemblies.

C. Division 09 - Painting.

D. Section 23 05 00 - Common Work Results for HVAC.

E. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

F. Section 23 07 00 - HVAC Insulation.

G. Section 23 31 16 - Hydronic Piping.

H. Section 23 23 00 - Refrigerant Piping

1.04 REFERENCES

A. ASME B31.1 - Power Piping.

B. ASME B31.2 - Fuel Gas Piping.

C. ASME B31.5 - Refrigeration Piping.

D. ASME B31.9 - Building Services Piping.

E. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM E119 - Method for Fire Tests of Building Construction and Materials.

G. ASTM A 194 - Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure and/or High Temperature Service.

H. ASTM A 307 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

I. ASTM A 575 - Steel Bars, Carbon, Merchant Quality, M-Grades.

J. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized).

K. ASTM A 675 - Steel Bars, Carbon, Hot-Wrought, Special Quality.

L. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.

M. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

N. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

O. ANSI/MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

P. ANSI/MSS SP69 - Pipe Hangers and Supports - Selection and Application.

Q. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

R. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

S. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

T. UL 1479 - Fire Tests of Penetration Firestops.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of [hydronic] [steam and steam condensate] piping.

1.06 SUBMITTALS

A. Submit under provisions of Division 01.

B. Shop Drawings.

C. Product Data: Provide manufacturers catalog data including load capacity.

D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.07 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handle products under provisions of the Supplementary Conditions.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Acceptable Manufacturers:

1. Anvil.
2. Eaton.
3. Erico.
4. Holdrite.
5. PHD Manufacturing, Inc.

B. Hydronic Piping:

1. Conform to ANSI/MSS SP58.
2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron, adjustable swivel, split ring for steel pipe, copper swivel for copper pipe.
3. Hangers for Hot Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers: Steel channels or strut with hanger rods. Cast iron roll and stand for hot pipe sizes 6 inches and over.
6. Wall Support for Pipe Sizes to 3 Inches: Strut triangular bracket with pipe clamp and cushion insulator.
7. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange or steel support.
10. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with felt isolation pad or all copper ring or swivel.

C. Refrigerant Piping:

1. Conform to ANSI/MSS SP58.

2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Vertical Support: Steel riser clamp.

7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with neoprene isolation pad.

D. Shield for Insulated Piping 1-½ Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180º segments, minimum 12 inches long at pipe support.

E. Shield for Insulated Piping 2 Inches and Larger: Hard block, calcium silicate insert, 180° segment, 12 inch minimum length, block thickness same as insulation thickness, flame resistant vapor barrier covering and 18 gauge galvanized shield.

F. Shields for Vertical Copper Pipe Risers: Galvanized steel pipe.

G. Design hangers to allow installation without disengagement of supported pipe.

H. Copper Plating: All hanger elements in metal-to-metal contact with copper pipe shall have copper plating, hanger rings with factory-applied 1/16 inch minimum thick plastic, or tape cushion strip over all contact surfaces.

I. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gage formed steel channels, 1-5/8 inch square, conforming to ASTM A653 GR33, one side of channel shall have a continuous slot with inturned lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electro-galvanized.

J. Fixed Roller Rooftop Pipe Supports for Pipe Sizes to 6 Inches and smaller: Foam bottom, UV stabilized thermoplastic base, with polymeric rollers and hot dip galvanized retraining strap. Size as required for pipe. Minimum 6" Height, utilize adjustable height as required.

2.02 HANGER RODS

A. Steel Hanger Rods: Mild steel, threaded both ends, threaded one end, or continuous threaded.

2.03 ANCHOR BOLTS

A. Anchor (Expansion) Bolts: Shall be carbon steel to ASTM A 307; nut shall conform to ASTM A194; shall be drilled-in type. Design values for shear and tension shall be not more than 80 percent of the allowable load.

2.04 FLASHING

A. Metal Flashing: 26 gauge minimum galvanized steel.

B. Metal Counter Flashing: 22 gauge minimum galvanized steel.

C. Lead Flashing: 5 lb./sq. ft. sheet lead for waterproofing; one lb./sq. ft. sheet lead for soundproofing.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.05 EQUIPMENT CURBS

A. Fabricate curbs of concrete, sheet metal, wood, or steel beam, as called out on the drawings, unless specifically called out otherwise.

2.06 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed caulking system.

D. Fire Stopping Insulation: Mineral fiber type, non- combustible.

E. Caulk: Fire stop sealant in compliance with ASTM E814, UL 1479 and Division 07.

F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install pipe hangers in accordance with ANSI/MSS-SP-69.

3.02 PIPE HANGERS AND SUPPORTS

A. Support piping as follows:

Pipe Size	Max. Hanger Spacing	Hanger Diameter
½ to 1-¼ inch	6'-0"	3/8"
1-½ to 2 inch	10'-0"	3/8"
2-½ to 3 inch	10'-0"	½"
4 to 6 inch	10'-0"	5/8"
8 to 12 inch	14'-0"	7/8"

Notes:

[a] See piping manufacturer installation instructions for additional requirements.

B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-½ inch minimum vertical adjustment.

E. Support vertical piping at every floor.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Design hangers for pipe movement without disengagement of supported pipe.

I. Provide copper plated hangers and supports for copper piping.

J. Support all piping on flat roofs using rooftop pipe supports. Install per manufacturer’s instructions. Install piping minimum 6” above roof surface.

3.03 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of where shown on plans and where required by equipment manufacturer installation instructions.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members. Brace and fasten with flanges bolted to structure.

D. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment anchors.

E. Provide rigid anchors for pipes after vibration isolation components are installed.

F. Anchor (Expansion) Bolts: Install anchor bolts for all mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at all equipment support points. Provide locknuts where equipment, piping, and ductwork is hung. Install anchor (expansion) bolts in holes drilled in concrete where necessary to hang piping or ductwork, or to anchor stationary equipment from existing concrete slabs.

3.04 FLASHING

A. Provide flexible flashing and metal counter-flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide curbs for mechanical roof installations minimum 24 inches high above roofing surface. Flexible sheet flash and counter-flash with sheet metal; seal watertight.

C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

D. Provide acoustical flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.05 SLEEVES

A. Set sleeves in position in construction. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors one inch above finished floor level. Pack and caulk sleeves full depth and provide floor plate.

D. Where piping or ductwork penetrates floor, ceiling, or wall, install sleeve, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal. Use fire rated caulking where area or occupancy separation walls are penetrated. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.06 INSTALLATION OF EQUIPMENT

A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.

B. Maintain manufacture recommended minimum clearances for access and maintenance.

C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.

D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, ductwork, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog.

E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.

F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc.

END OF SECTION

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section provides minimum acceptance requirements for vibration isolation and seismic/wind restraints for HVAC equipment, piping, and ductwork where vibration isolation or seismic restraint is required by code or specified herein.

1.02 GENERAL

A. The requirements for seismic protection measures to be applied to plumbing equipment and systems specified herein are in addition to any other items called for in other sections of these specifications.

1.03 HVAC PIPING, DUCTWORK AND EQUIPMENT

A. This section provides minimum acceptance requirements for vibration isolation and seismic/wind restraints for all HVAC equipment, piping and ductwork. HVAC equipment shall include all items on mechanical plans or in other sections of the Division 23 specifications. Equipment shall include but not be limited to:

1. Boilers
2. Air Separators.
3. Expansion tanks
4. Glycol Tanks.
5. Pumps.
6. Hydronic Piping.
7. Natural Gas Piping.
8. Ductwork.
9. Air handling units.
10. Condensing Units.
11. Heat Exchangers.
12. Fans.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Vibration isolation and seismic/wind restraints for plumbing systems are specified elsewhere in Division 22.

B. Vibration isolation and seismic restraints for electrical systems are provided in Division 26.

1.05 QUALITY ASSURANCE

A. The following codes and standards will apply:

1. International Building Code.

2. American Society of Civil Engineers (ASCE) 7-16.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control and wind restraint products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. The following guides may be used for supplemental information on typical seismic installation practices:

1. Federal Emergency Management Agency (FEMA) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.

2. Sheet Metal and Air-conditioning Contractors' National Association's (SMACNA) Seismic Restraint Manual Guidelines for Mechanical Systems.

3. American Society for Heating, Refrigerating and Air-conditioning Engineers' (ASHRAE) A Practical Guide to Seismic Restraint.

4. Manufacturers Standardization Society of the Valve and Fittings Industry MSS SP-127-2014a, Bracing for Piping Systems, Seismic - Wind - Dynamic, Design, Selection, Application.

1.06 COMPONENT IMPORTANCE FACTOR

A. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor (Ip) on the basis of the following:

Ip = 1.5 Natural gas piping, fuel oil piping, medical gas piping, vacuum piping, petroleum based liquid piping, compressed air piping and any other piping carrying hazardous materials.

Ip = 1.0 All other components.

1.07 SUBMITTALS

A. Submit shop drawings and manufacturer's data in accordance with Division 01.

B. Provide calculations for selection of seismic/wind restraints in accordance with IBC and ASCE 7, certified by a qualified professional engineer, licensed in the state of the project.

C. Submit adequate number of City Plan Review department set of shop drawings and seismic calculations for their review. Submit to City plan review and owner concurrently. Submit plan review approved set to Engineer when available. The submittals must include a licensed engineer's stamp and signature and shall be provided as deferred submittal.

D. Provide Seismic Restraint plans and calculations for FM Global (Factory Mutual) review. Design parameters for these installations, may be obtained from FM Global prior to system design.

FM Global – Plan Review

601 – 108th Avenue NE, Suite 1400

P.O. Box 96077

Bellevue, WA 98004

Tel. (425) 455-5333

E. Provide Vibration isolation shop drawings shall include isolator locations, load on each isolator, and include installation instructions.

F. All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.

G. Submit shop drawings and calculations for all vibration isolation and seismic restraint systems required by this Section. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachment and anchorage requirements.

H. Provide Shop drawings along with catalog cuts, templates and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal; and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1. Sway Braces.
2. Vibration Isolators.
3. Seismic Cable Restraint.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Vibration isolators and Seismic Restraint shall be manufactured by:

1. Caddy.
2. Cooper Industries/Eaton.

3. Gripple.
4. International Seismic Application Technology.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibro-Acoustics by Swegon.
8. VMC Group.
9. Substitutions: Items of same function and performance are acceptable in conformance with Division 01.

2.02 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.
2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in installation requirements.
5. The total height of the structure (h) and the height of the system to be restrained within the structure (z) shall be determined in coordination with architectural plans and the General Contractor.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

2.03 SEISMIC BRACING COMPONENTS

A. Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.

1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33.
2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33.
3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.

4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS. Gr.33.

5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

2.04 VIBRATION ISOLATION AND RESTRAINTS

A. Provide vibration isolation for mechanical equipment as indicated and as required to prevent transmission of vibration to the building structure.

B. Isolators shall be selected based on equipment weight and operating speed and shall provide uniform loading and deflection.

C. All vibration isolators serving equipment subject to seismic or wind restraint shall be seismically rated or provided with integral seismic restraint.

D. Boilers and Pumps:

1. Boilers and pumps shall be provided with vibration isolation consisting of restrained spring isolators or neoprene isolators selected for the equipment weight and operating characteristics.

a. Minimum static deflection: 0.75 inches unless noted otherwise.

b. Provide isolation bases where required to support vibration isolators or as recommended by the equipment manufacturer.

c. Provide flexible connectors at all piping connections to vibration-isolated equipment.

d. Do not allow rigid contact between isolated equipment and structure.

E. Rooftop Equipment (RTUs, Condensers, Fans) Over Noise-Sensitive Spaces

1. Roof-mounted air handling units and condensing units located above or adjacent to noise-sensitive spaces shall be provided with an engineered vibration isolation and seismic restraint system.

2. Provide a coordinated two-stage isolation system consisting of:

a. Factory-installed internal fan and motor vibration isolation.

b. External spring isolation roof curbs with integral seismic and wind restraint.

3. The combined isolation system shall be engineered and certified by the vibration isolation manufacturer or specialty engineer to prevent resonance, excessive movement, and transmission of vibration to the structure.

a. Isolation Curbs

1) Provide spring isolation roof curbs designed for the installed equipment weight and applicable wind and seismic loads.

a) Minimum static deflection: 1.0 inch unless otherwise recommended by the isolation manufacturer.

b) Provide continuous perimeter support.

c) Provide flexible duct and piping connections.

b. Internal Equipment Isolation

1) RTUs shall be furnished with factory-installed internal fan and motor vibration isolation.

2) Internal isolators shall remain active unless the equipment manufacturer and isolation system designer recommend otherwise as part of the engineered isolation design.

F. Ductwork and Piping Near Isolated Equipment

1. Provide vibration isolation for piping and ductwork directly connected to vibration-isolated equipment for the first 50 feet or as required to prevent vibration transmission.

a. Use spring hangers or neoprene hangers as applicable.

b. Provide flexible connectors at equipment connections.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.

B. Coordinate locations and sizes of structural supports with locations of vibration isolators and seismic/wind restraints.

C. Isolated and restrained equipment and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved by the restraint manufacturer.

3.02 SEISMIC/WIND RESTRAINTS

A. General:

1. All equipment and piping shall be restrained to resist seismic/wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts,

welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations. Additional requirements specified herein are included specifically for this project.

2. Install seismic and wind restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

3. Attachment to structure for suspended equipment and pipe: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.

5. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

6. Where rigid restraints are used on equipment or piping, support rods for the equipment or piping at restraint locations must be supported by anchors rated for seismic use.

7. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.

B. Concrete Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre- or post-tensioned tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Mechanical Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

C. Equipment Restraints:

1. Seismically restrain equipment as required. Install fasteners, straps and brackets as required to secure the equipment.

D. Duct Systems:

1. Seismically restrain all ductwork listed below, using seismic cable restraints:

   a. All ducts with cross-sectional area equal to or greater than 6 ft2 (0.55 m2).

   b. Any ductwork which if it were to fail would result in damage to a piece of equipment or building function that has a component importance factor of 1.5.

   c. All ductwork weighing more than 17 lbs/ft (25 kg/m).

2. "12-inch rule", where duct can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:

   a. The hangers shall be detailed to avoid significant bending of the hangers and their attachments. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.

   b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.

3. Space lateral supports a maximum of 30' o.c. (9 m), and longitudinal supports a maximum of 60' (18 m) o.c.

4. Duct risers shall be restrained at floor penetrations every 30' (9 m) maximum spacing.

5. Brace a change of direction longer than 12' (3.7 m).

6. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

E. Piping Systems:

1. For projects with a Seismic Design Category of D, provide seismic cable restraints on the following:

   a. All piping greater than 3" (75 mm) nominal diameter.

   b. All piping systems assigned a component importance factor, Ip, of 1.5 with a nominal pipe diameter greater than 1" (25 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).

2. "12-inch rule", where pipe can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:

   a. Hangers are detailed to avoid bending of the hangers and their attachment; and provisions are made for piping to accommodate expected deflections. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.

b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.

3. Restraint spacing:

a. For ductile piping, space lateral supports a maximum of 40' (12 m) o.c., and longitudinal supports a maximum of 80' (24 m) o.c.

b. For non-ductile piping (e.g., cast iron, PVC) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.

c. For piping with hazardous material inside (e.g., natural gas, medical gas) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.

d. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.

4. Brace a change of direction longer than 12' (3.7 m).

5. Longitudinal restraints for single pipe supports shall be attached directly to the pipe, not to the pipe hanger.

6. For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.

7. Piping on roller supports shall include a second roller support located on top of the pipe at each restraint location to provide vertical restraint.

8. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

9. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.

10. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

11. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.

3.03 VIBRATION ISOLATION

A. Block and shim all bases level so that all piping and electrical connections can be made to a rigid system at the proper operating level, before isolators are adjusted. Ensure that there are no rigid connections or incidental physical contacts between isolated equipment and the building structure or nearby systems.

B. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors.

C. Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

D. There shall be no rigid contact of isolated piping or equipment with shaft walls, floor slabs, partitions, or conduits.

E. Provide height-saving brackets where recommended by the manufacturer for equipment stability, or operating height requirements.

F. Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.

G. Provide spring-loaded thrust restraints for fans and air handling units where movement under any operating condition will exceed 3/8" (10 mm).

H. Isolator hangers shall be installed with the housing a minimum of 1/4" (6 mm) below but as close to the structure as possible. Where isolator hangers would be concealed by non-accessible acoustical sub ceiling, install the hangers immediately below the sub ceiling for access.

3.04 INSPECTION AND CERTIFICATION

A. After installation, arrange and pay for the vibration isolation product manufacturer, or representative, to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

B. After installation, arrange and pay for the seismic restraint product manufacturer, or representative, to visit the site to verify that the seismic and wind restraint systems are installed properly, and shall submit a certificate so stating.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes identification of HVAC piping, ductwork and equipment installed under Division 23.

B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.03 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include product data on: Nameplates, tags, stencil and paint, and pipe markers.

1.05 QUALITY ASSURANCE

A. Conform to ANSI/ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seton.

B. Marking Services Inc.

C. Craftmark Identification Systems.

D. Substitutions: Under provisions of Division 01.

2.02 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic, minimum 1/16” thick, with engraved black or white letters on contrasting background color. Plate size minimum ¾" X 2-½".

C. Plastic Tags: Laminated three-layer plastic with engraved black or white letters on contrasting background color. Tag size minimum 1-½ inch square.

D. Metal Tags: Brass with stamped letters; tag size minimum 1-½ inch diameter with smooth edges.

E. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed. Larger sizes may have maximum sheet size with spring fastener.

F. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

G. Valve Chart Frame: Aluminum frame with plastic windows.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags using corrosion resistant chain. Number tags consecutively by location.

E. Equipment: Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with plastic or metal tags.

F. Identify control panels and major control components outside panels with plastic nameplates.

G. Identify valves in main and branch piping with tags showing service and valve number.

H. Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Ductwork: Identify ductwork with plastic nameplates or stencil. Identify as to air handling unit number, and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

J. Locations: Nameplates shall be located so as to be readily visible to maintenance personnel. Motor nameplates shall be readily visible on accessible, three phase motors, otherwise a duplicate motor nameplate shall be permanently affixed to the driven machinery in a visible locations.

3.03 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule at location as directed by Owner. Chart shall show valve number, service and normal position. Valve numbering shall match facility existing valve numbering scheme. Provide a reduced scale copy of drawings showing valves and valve number. Provide copies of valve chart and drawings for inclusion in operation and maintenance manuals in accordance with Section 23 05 00.

END OF SECTION

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 WORK INCLUDED

A. Air Systems:

1. Constant Volume Air Systems.
2. Variable Air Volume Systems.
3. Space Pressurization.
4. Shaft Pressurization Systems.
5. Existing HVAC Systems.

B. Hydronic Systems:

1. Constant Flow Systems.
2. Primary-secondary Systems.

1.02 SCOPE

A. Furnish the professional services of a qualified and approved balancing and testing firm to perform the work of this specification section.

B. The work of this section includes but is not necessarily limited to:

1. Testing and balancing existing hydronic heating and ventilation systems as indicated on drawings.
2. Testing and balancing fans and air handling systems.
3. Testing and balancing new variable air volume terminal units.
4. Testing and balancing new liquid heat transfer systems.
5. Working directly with the control subcontractor to obtain proper system adjustments.
6. Domestic water distribution system adjustment.

C. The work of this section does not include:

1. Adjusting burners for proper combustion operation.
2. Liquid waste transfer system adjustment.
3. Fire protection systems.

1.03 APPLICABLE CODES AND STANDARDS

A. SMACNA Manual for the Balancing and Adjustment of Air Distribution Systems.

B. AMCA Publication 203, Field Performance Measurements.

C. American Air Balancing Council (AABC) Recommended Procedures

D. National Environmental Balancing Bureau (NEBB) Recommended Procedures

1.04 QUALIFICATION OF THE BALANCING FIRM OR COMPANY

A. Subcontractor minimum qualifications include:

1. NEBB Certified in Testing, Adjusting and Balancing of Air and Hydronic Systems and Demonstration of satisfactory completion of five projects of similar scope in the State of Alaska during the past five years. Provide references if requested.

1.05 PRE-CONSTRUCTION TESTING, ADJUSTING, AND BALANCING

A. Prior to commencement of demolition or construction activities affecting HVAC systems, provide Testing, Adjusting, and Balancing (TAB) of existing systems to establish baseline operating conditions.

B. Pre-construction TAB shall document the existing performance of HVAC systems and shall include, at a minimum:

1. Airflow at supply, return, and exhaust terminals.

2. Terminal unit airflows and temperatures.

3. Fan airflows, static pressures, and rotational speeds.

4. Space temperatures and system operating modes.

5. Hydronic system flow rates, pump operating conditions, and temperatures at all heat exchangers, heating plants, heating coils, and terminal heating units.

6. Identification of non-operational, inaccessible, or deficient components.

C. Perform pre-construction TAB using the same standards, instrumentation, and reporting format required for final TAB.

D. Submit a pre-construction TAB report identifying measured values as existing conditions prior to construction. This report shall serve as the baseline reference for post-construction TAB comparison.

E. Pre-construction TAB does not require adjustment of systems unless specifically directed by the Engineer. Report observed deficiencies and operating limitations without correcting them unless authorized.

F. Post-construction TAB shall document final system performance and shall be compared to pre-

construction TAB results to verify system changes resulting from the Work.

1.06 POST-CONSTRUCTION TESTING, ADJUSTING, AND BALANCING

A. Do not begin post-construction testing and balancing until systems have been verified ready in accordance with Pre-Tab Readiness requirements.

B. Schedule the testing and balancing work in cooperation with other trades.

C. Complete the testing and balancing at least one week before the date of substantial completion and before any occupancy occurs

1.07 CONTRACTOR RESPONSIBILITY TO BALANCING AGENCY

A. Award the test and balance contract to an approved firm or company upon receipt of contract to allow the Balance and Testing Agency to schedule this work in cooperation with other trades involved and comply with completion date.

B. Put all heating, ventilating and air conditioning systems, equipment and controls into full operation for the Balancing Agency and continue the operation of same during each working day of testing balancing.

C. Provide scaffolding, ladders and access to each system for proper testing balancing.

D. Ensure that the building enclosure is complete, including but not limited to, structural components, windows and doors installed, door hardware complete, ceilings complete, stair, elevator and mechanical shafts complete, roof systems complete, all plenums sealed, etc.

E. Make any changes in pulleys, belts and dampers, or add any dampers as required for correct balance as recommended by the Balance and Testing Agency at no additional cost to the Owner.

F. Complete installation, programming (including design parameters and graphics), calibration, and startup of all building control systems.

G. Require that the building control system firm provide access to hardware and software, or onsite technical support required to assist the TAB effort. The hardware and software or the onsite technical support shall be provided at no cost to the TAB firm.

1.08 REPORT

A. Certified Reports shall be included in project O & M manuals. Reports shall include: testing, adjusting, and balancing reports bearing the signature of the Test and Balance Agency Representative. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the system. Follow the procedures and format specified below:

1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports.

2. Final Reports: Upon verification and approval of the draft report; prepare final reports, typewritten, organized and formatted as specified below.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Report shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed. Divide the contents into the below listed sections, with bookmarks for each section:

    a. General Information and Summary.

    b. Air Systems.

    c. Hydronic Systems.

    d. Temperature Control Systems.

    e. Special Systems.

    f. System Deficiency Reports and Corrective Actions.

4. Report Contents: Provide the following minimum information, forms and data:

    a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency; contractor; owner, architect, engineer and project. Include addresses, contact names and telephone numbers. Also, include a certification sheet containing the name, address, telephone number and signature of the Certified Test and Balance Personnel. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.

    b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

    c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.09 SUBMITTALS

A. Submit in accordance with Division 01.

B. Submit balancing agency qualifications and sample balancing forms.

C. Provide list of equipment to be used and date of last calibration.

D. Submit preliminary balance report a minimum of one week prior to substantial completion inspection.

PART 2 PRODUCTS

2.01 INSTRUMENTS

A. Maintain all instruments accurately calibrated and in good working order. Use instruments with the following minimum performance characteristics.

1. Air Velocity Instruments: Direct reading in feet per minute, 2% accuracy.

2. Static Pressure Instruments: Direct reading in inches' water gauge, 2% accuracy.

3. RPM Instruments: Direct reading in revolutions per minute, .5% accuracy; or revolution counter accurate within 2 counts per 1,000.

4. Pressure Readout: Direct reading in feet of water or PSI, .5% accuracy.

5. Temperature Instruments - Direct reading in degrees F, +.5% accuracy.

6. Water Flow Instruments: Differential pressure type; direct reading in feet of water or PSI, accuracy, suitable for readout balancing valve provided.

7. Sound Measuring Instrument: Octave Band Analyzer which essentially complies to AASA Standards SI.6 1960 with a range of 24DB to 150 DB sound pressure level ref. .0002 microbar. Calibrate sound test instrument before use to a closed coupler and a driving loudspeaker that produces a know-sound pressure level at the microphone of the analyzer.

PART 3 EXECUTION

3.01 PRE-TAB SYSTEM READINESS REQUIREMENTS

A. Prior to commencement of Testing, Adjusting, and Balancing (TAB) work, all HVAC systems and components shall be complete, operational, and ready for balancing. The Mechanical Contractor shall certify in writing that systems are ready for TAB and that the following conditions have been satisfied:

1. All equipment is installed, started, and operating in accordance with the Contract Documents and approved submittals.

2. All ductwork and piping systems are complete, leak-tested, cleaned, and insulated.

3. All terminal units, coils, dampers, valves, and diffusers are installed, accessible, and operational.

4. All air distribution devices are installed after completion of ceilings and architectural finishes affecting airflow patterns.

5. All filters are installed and clean.

6. All control systems are installed, programmed with design parameters, calibrated, and fully operational.

7. All automatic dampers and control valves are operational and in their normal operating positions.

8. All hydronic systems are filled, vented, flushed, and chemically treated as specified.

9. All variable frequency drives (VFDs) and control sequences are functional and tuned for normal operation.

10. The building envelope is complete, including windows, doors, roofs, shafts, and plenums affecting pressurization.

B. TAB work shall not begin until the Mechanical Contractor provides written verification of system readiness to the Engineer and TAB Agency.

3.02 GENERAL PROCEDURES FOR ALL SYSTEMS

A. Start with new, clean filters.

B. In cooperation with the control manufacturer's representative, coordinate adjustments of automatically operated dampers and valves to operate as specified, indicated and/or noted.

C. Use manufacturer's ratings on all equipment to make required calculations.

D. Make final adjustments for each space per heating or cooling comfort requirement. State reason for variance from design CFM, i.e., "too noisy", "drafty", etc.

E. Mark equipment and balancing device settings (including damper-control positions, valve position indicators, fan-speed-controls, and similar controls and devices) with paint or other suitable permanent identification material to show final settings.

3.03 REQUIREMENTS FOR ALL AIR HANDLING SYSTEMS

A. Identify each diffuser, grille and register as to location and area.

B. Identify and list size, type and manufacturer of diffusers, grilles, registers and all testing equipment.

C. In readings and tests of diffusers, grilles and registers, include required FPM velocity and required CFM and test CFM after adjustments. If test apparatus is designed to read CFM directly, velocity reading may be omitted. Identify test apparatus used. Identify wide open (W.O.) runs.

D. Check and record the following items:

1. Air temperatures; mixed air, after coils, outside air, return air and supply air.

2. Pressure drop at each coil, filter bank, etc.
3. Operating suction and discharge pressure.
4. Full nameplate data of all equipment.
5. Rated and actual running amperage and voltage of all motors.
6. Drive data including sheaves and belts and adjustments.
7. Electrical overloads/heaters sizes and ranges of motors.

3.04 BALANCING LOW VELOCITY CONSTANT VOLUME DUCTWORK

A. Analyze system and identify major branches. Tabulate design CFM for each branch.

B. Select the branch which appears to be the longest run from the fan or to have the highest static pressure requirements.

C. Adjust other branch dampers or the fan to establish 110% design air flow through the selected branch.

D. Adjust the air flow through each air inlet (exhaust systems) or outlet (supply systems) on the selected branch to within +5% of the requirements so that at least one branch damper serving an inlet (or outlet) is wide open.

E. Proceed to another branch and set up 110% design airflow. Balance each inlet or outlet to within +5% of requirements, again leaving at least one wide open run. Repeat this process until all branches are balanced 110% airflow.

F. Once each branch has been balanced at 110% flow with one wide open run on each branch, balance with branches together, leaving at least one branch damper wide open. At this point, adjust the fan delivery so that each branch is at about 110% design airflow. Adjust the branch dampers so that each inlet (or outlet) in the system is within 10% of the required airflow.

G. Adjust the fan for design airflow.

H. Read and record the airflow at each inlet and outlet.

I. Secure each branch damper and mark the balanced position of the damper quadrant.

J. Test and record entering and leaving air temperatures of coils.

K. Test and record entering and leaving water temperatures of coils.

L. Test and record static pressure drop across each filter and coil bank.

3.05 BALANCING VAV AIR SYSTEMS

A. The high velocity ductwork of the Variable Air Volume (VAV) systems are computer designed and

in general should not require special balancing. The balancer must, however, check the CFM's and adjust as necessary and work with the Control Contractor to set up the fans and controls for proper operation through the range of system operation. The balancing essentially consists of the following:

1. Set up and adjust each fan.
2. Set up duct static pressure control.
3. Balance ductwork and mixing boxes, air outlets, terminal units, etc.
4. Set up building static pressure control.

B. Step 1: Adjust all thermostats set points to call for full airflow. Adjust supply air temperature so that terminal units will stay in full airflow position. If system diversity exceeds 80%, some boxes may have to be temporarily closed.

C. Step 2: Adjust variable speed drive controller to provide 100% fan CFM volume. Check current draw on motor. Do not exceed nameplate full load current rating. Adjust fan RPM accordingly.

D. Step 3: Proceed with the adjustment of diffusers downstream of each terminal box. Proceed as though each box were a branch on a constant volume system. Adjust thermostats of nearby boxes or adjust fan delivery to bring the total terminal box airflow to within + 10% of design box airflow. Record data. Establish a wide-open run and balance the diffusers to within +5% of percentage of total box airflow to design box airflow.

E. Step 4: At each terminal box, adjust the high-volume limiter to the CFM scheduled on the computer run to the total air flow scheduled through the box. Coordinate with the control subcontractor and adjust the low volume limit. Record correction factor for each box.

F. Step 5: Upon completion of all the diffuser adjustments at each terminal box in all zones, place enough thermostats to the no flow position to compensate for diversity. These should be randomly selected based on judgment as to how diversity applies to the particular air distribution system, considering building use. The object is to create 100% airflow at the fan.

G. Step 6: Adjust the static pressure sensor controlling the variable speed drive to the specified setting for its location in the duct system and adjust fan for 100% CFM at wide open RPM. Record fan suction and discharge static pressure, fan CFM, RPM, motor amperage and voltage, filter and coil pressure drops and static pressure at control sensor location. Refer to procedure for constant volume fan adjustment.

H. Step 7: Work with control subcontractor to set up all fan system controls and building static pressure control. Readjust space thermostats set points.

3.06 FLUID SYSTEM TESTING AND BALANCING

A. Preparation of system - Phase I:

1. Complete air balance before beginning fluid balance.

2. Clean all strainers.

3. Examine fluid in system to determine if treated and clean.

4. Check pump rotation.

5. Verify expansion tanks are not air bound and system full of fluid.

6. Verify all air vents at high points of fluid systems are installed properly and are operating freely. Make certain all air is removed from circuiting system.

7. Open all valves to full flow position including coil and heater stop valves, close bypass valves and open return line balancing cocks. Set temperature controls so that automatic valves are open to full flow through apparatus.

8. Check and set operating temperature of boilers and heat exchangers to design requirements when balancing by temperature drop.

9. Adjust all flows to 110% of design flows as shown.

B. Test and Balance Procedure - Phase II:

1. Set pumps to proper GPM delivery and set proper GPM delivery in main piping runs from boiler room. Note flow variations for additive alternates.

2. Adjust flow of fluid through primary equipment.

3. Check leaving fluid temperatures and return fluid temperatures and pressure drop through major equipment. Reset to correct design temperatures.

4. Check fluid temperature at inlet side of coils and other heat transfer equipment. Note rise or drop of temperatures from source.

5. Balance each coil and all other heat transfer apparatus in system.

6. Upon completion of flow readings and adjustments, mark all settings and record all data.

C. Test and Balance Procedure - Phase III:

1. After making adjustments to coils and apparatus, recheck settings at pumps and major equipment. Readjust if required.

2. Attach pressure gauges on each coil, then read pressure drop through coil at set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop. This prevents unbalanced flow conditions when coils are on full bypass.

3. Check and record the following items with flows set at 100% of design.

a. Inlet and leaving fluid and air temperatures at coils and major equipment.

b. GPM flow of each coil and major equipment.

c. Pressure drop of each coil and major equipment.

d. Pressure drop across bypass valve.

e. Pump operating suction and discharge pressures and final total developed head.

f. Pump GPM.

g. Rated and actual running amperage and voltage of pump motor.

h. Full nameplate data of all pumps and equipment.

i. Electrical overloads/heaters sizes and ranges of motors.

4. Permanently mark adjusted position of all balancing valves. Stamp indicator plate of circuit setters and other balancing valves without memory stop.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping Insulation.

B. Equipment Insulation.

C. Ductwork Insulation.

D. Jackets and Accessories.

1.02 RELATED WORK

A. Division 09 - Painting.

B. Section 23 05 00 - Common Work Results for HVAC Systems.

C. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

D. Section 23 05 19 - Meters and Gages for HVAC Piping.

E. Section 23 21 13 - Hydronic Piping.

F. Section 23 21 16 - Hydronic Specialties.

G. Section 23 23 00 - Refrigeration Piping.

H. Section 23 31 00 - HVAC Ducts and Casings.

I. Section 23 33 00 - Air Duct Accessories.

J. Section 23 57 00 - Heat Exchangers for HVAC.

1.03 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.

B. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

D. ANSI/ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

E. ANSI/ASTM C547 - Mineral Fiber Pipe Insulation (Preformed).

F. ANSI/ASTM C552 - Cellular Glass Thermal Insulation.

G. ANSI/ASTM C553 - Mineral Fiber Blanket Insulation.

H. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

I. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

J. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

K. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

L. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

M. ASTM C1427 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

N. ASTM D774 - Standard Test Method for Bursting Strength of Paper.

O. ASTM D1000 - Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.

P. ASTM E84 - Surface Burning Characteristics of Building Materials.

Q. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

R. UL 723 - Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include product description, thickness for each service, and locations.

C. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with three years minimum experience.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723, ASTM E84.

D. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Shipment of materials from manufacturer to installation location shall be in weather tight transportation.

D. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesive, mastics, and insulation cements.

1.08 FIELD MEASURMENTS

A. Verify field measurements prior to fabrication.

1.09 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Armacell.

B. Certain-Teed.

C. Johns Manville.

D. Owens-Corning.

E. Manson.

F. Pittsburgh - Corning.

G. K-Flex USA.

H. Substitutions: Under provisions of Division 01.

2.02 INSULATION - PIPING

A. Type A: Glass fiber, rigid, molded, non-combustible insulation; ANSI/ASTM C547; 'k' value of 0.23 at 75º F, rated from 0º F to 850º F, vapor retarder jacket of Kraft paper bonded to aluminum foil, self-sealing lap and butt strips; Johns Manville "Micro-Lok" or approved equal.

B. Type E: Elastomeric foam; EPDM-based closed-cell flexible foam, ASTM C534; flexible cellular elastomeric in sheet or pre-formed tube, 'k' value of 0.26 at 75º F, max. service temp - 300º F, ASTM C534; max. flame spread = 50, max. smoke developed = 50, ASTM E84; UV-resistant coating/jacketing if exposed to sunlight; K-FLEX USA "Insul-Tube", "Insul-Sheet", or approved equal.

C. Type F: Hydrous calcium silicate; ANSI/ASTM C533; rigid white; asbestos free; 'k' value of 0.44 at 300º F, rated to 1,200º F; Johns Manville "Thermo 12 Gold" or approved equal.

2.03 FIELD APPLIED PIPING JACKET

A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.

B. PVC Jackets and solvent welding adhesive: One piece, pre-molded type, Johns Manville "Zeston 2000", fitting covers and jacketing material. Johns Manville "Perma-Weld" solvent welding adhesive.

C. Re-Wettable Canvas Jacketing: , Fiberglass cloth made from texturized yarns, impregnated throughout with an inorganic fire retardant asbestos free adhesive; 20x14 thread count, 14.5 oz./sq.yd, 0.04 inch thickness, 1,000º F upper temperature limit; GLT Products "Style 1989" or approved equal.

2.04 INSULATION - EQUIPMENT

A. Type H: Reusable Thermal Insulation Covers, HVAC Equipment: 2" thermal insulating wool, 2.4 lb./cu.ft. density, maximum temperature rating of 1000 Deg. F; Interior/Exterior Fabric: 17 oz./sq. yd. silicone coated fiberglass cloth, maximum temperature range of -80 to 500 Deg F; Securement: Lacing Anchors, fourteen gauge stainless steel with 1.5" diameter stainless steel speed washers; Sewing Thread: Kevlar/Stainless Steel S-110 Natural with stainless steel core, all blanket seems to be single sewn lock stitch interior seams, six to nine stitches per inch; Drawcord: 0.125" diameter #4 ultra-strength polyester. Thermal Energy Products "Energy-Wrap EW.2T.NM.SH.SC" or approved equal.

B. Type I: Reusable Valve Wrap Insulation Covers: Removable and reusable wraps packaged with a 1" thick fiberglass blanket insert to completely cover the insulated equipment. The outer cover of the shall be made of DuPont Tychem® QC that is secured with a Velcro closure. Tychem® QC consists of a durable Tyvek® substrate quality coated with polyethylene that is impermeable to water. K= .28 @ 100º F; Temperature Limits 0°F to 450°F; Water Vapor Transmission ASTM E 96 0.01 Perms at 37.8C/100F-RH/100%; Breaking Strength Grab (md/cd) ASTM D5034-90 43/49 lbs; Tearing Strength Trapezoid (md/cd) ASTM D1117-80 7/5 lbs; Weatherable Grade; UV resistant; White/gloss finish; UL25/50 rating and are non-combustible per ASTM E 136. NOSWEAT Reusable Valve Wraps or approved equal.

2.05 INSULATION - DUCTWORK

A. Type K: Exterior FSK Duct Wrap: Flexible glass fiber; ASTM C553; commercial grade; 'k' value of 0.27 at 75º F, 0.6 lb./cu. ft. density. 0.00035 inch vinyl scrim facing with 2" stapling tab. Johns Manville "Microlite Standard Duct Wrap" or equal.

B. Type L: Exterior FSK Rigid Fiber Board Duct Insulation; ASTM C612, ‘k’ value of 0.23 at 75° F, 3.0 lb./cu. ft. density. 0.00035 inch foil scrim facing. Johns Manville “814 Spin-Glas” or equal.

C. Type N: Duct Liner: Close cell, CFC- and HCFC-free flexible elastomeric acoustical insulation with scrim-reinforced acrylic adhesive on one side; ASTM C534 type 2 (sheet) grade 1, ASTM E84 25/50 at 2" and below; 'k' value of 0.25 at 75° F; R-4.2 and noise reduction coefficient (NRC) of 0.5 at 1" thick; recommended for -40 to 200° F temperature applications; install metal nosing for air velocities greater than 4,000 ft./min., UL listed adhesive galvanized steel pins. K-flex USA "K-flex duct liner gray" or approved equal.

2.06 FIELD APPLIED EQUIPMENT AND DUCTWORK JACKETS

A. Re-Wettable Canvas Jacketing: , Fiberglass cloth made from texturized yarns, impregnated throughout with an inorganic fire retardant asbestos free adhesive; 20x14 thread count, 14.5 oz./sq.yd, 0.04 inch thickness, 1,000º F upper temperature limit; GLT Products “Style 1989” or approved equal.

2.07 INSULATION ACCESSORIES

A. Adhesives: Waterproof and fire-retardant type.

B. Lagging Adhesive: Fire resistive to ASTM E84 and UL 723.

C. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.

D. Joint Tape: Glass fiber cloth, open mesh.

E. FSK Joint Tape; ASTM C1136 Foil-Scrim-Kraft (FSK) lamination coated with solvent acrylic pressure sensitive adhesive; capable of adhering to fibrous and sheet metal surfaces; tri-directionally reinforced 2x3 squares per inch fiberglass scrim; 9.5 mils thick, -40 to 240º F service temperatures; Venture Tape “1525CW” or approved equal.

F. Tie Wire: Annealed steel, 16 gauge.

G. Insulated pipe supports: Calcium silicate with galvanized steel jacket (min. 24 gauge); ANSI/ASTM C533; rigid white; 'k' value of 0.37 at 100º F, rated to 1,200º F; Thermal Pipe Shields “T-2000 Calsil” or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Install materials after piping, equipment and ductwork has been tested and approved.

B. Clean surfaces for adhesives.

C. Prepare surfaces in accordance with manufacturer's recommendations.

3.02 INSTALLATION – PIPING INSULATION

A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

B. Continue insulation vapor barrier through penetrations except where prohibited by code.

C. Locate insulation and cover seams in least visible locations.

D. Neatly finish insulation at supports, protrusions, and interruptions.

E. Provide insulated cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Insulate complete system, including under fitting jackets.

F. For insulated pipes conveying fluids above ambient temperature, secure jackets with self-sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions. Insulate complete system, including under fitting jackets.

G. Provide insulated piping supports on piping 1-½" inch diameter or larger. Insulated piping supports shall not be less than the following lengths:

1-½" to 2-½" pipe size	10" long
3" to 6" pipe size	12" long

H. Fully insulate all piping including all spaces under jacketing.

I. Jackets:

1. Indoor, Concealed Applications: Insulated pipes shall have vapor barrier jackets, factory-applied. Vapor barrier PVC fittings may also be used provided joints are sealed with solvent welding adhesive approved by the jacket manufacturer.

2. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 feet above finished floor, finish with PVC jacket and fitting covers or metal jacket.

3.03 SCHEDULE – PIPING

PIPING	TYPE	PIPE SIZE	MINIMUM INSULATION THICKNESS
Heating Glycol/Water Supply and Return	A	1-1/4” and Smaller	1-1/2”
Heating Glycol/Water Supply and Return	A	1-1/2" and Larger	2”
Boiler Feed Water	A	All Sizes	1"

PIPING	TYPE	PIPE SIZE	MINIMUM INSULATION THICKNESS
Cold Condensate Drains	A	All Sizes	1"
Refrigerant Suction Piping	E	All Sizes	1"
Refrigerant Liquid Piping	E	All Sizes	1"
Piping Exposed to Freezing	A	All Sizes	2"

3.04 INSTALLATION - EQUIPMENT

A. Install materials in accordance with manufacturer's instructions.

B. Do not insulate factory insulated equipment.

C. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands. Minimum 2" overlap on blanket material.

D. Cover insulation with metal mesh and finish with heavy coat of insulating cement.

E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

F. When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.

G. Where canvas jacketing is indicated, apply mastic in sufficient thickness to completely cover the texture of the canvas material.

3.05 SCHEDULE - EQUIPMENT

EQUIPMENT	INSULATION TYPE	THICKNESS
Air Separator	H	2"
Heat Exchangers	H	2"
Valves, 2” and Larger	I	2”
Flue Gas Breeching	F	2"
Stacks to Roof	F	2"

3.06 INSTALLATION – DUCTWORK INSULATION

A. Install materials in accordance with manufacturer's instructions.

B. Provide insulation with vapor barrier when air conveyed may be below ambient temperature. Continue insulation with vapor barrier through penetration.

C. Duct Exterior Insulation (Type K,L) Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Secure insulation without vapor barrier with staples, tape, or wires.

3. Install without sag on underside of ductwork. Use mechanical fasteners to prevent sagging. Secure insulation with mechanical fasteners on 15 inch centers maximum, on bottom and side of ductwork with dimension exceeding 20 inches. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

4. Maximum 25% compression.

D. Fiber-Free Duct Liner (Type N) Application:

1. Adhere insulation with approved adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 15 inch centers maximum on top and side of ductwork with dimension exceeding 20 inches. Butt joints together tightly then seal and smooth. Thoroughly coat ends of liner with adhesive. Do not use nail-type fasteners. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

2. Ductwork dimensions indicated are net inside dimensions required for air flow. Increase ductwork to allow for insulation thickness.

3. Install liner as indicated on plans.

E. Where ductwork is scheduled for exterior insulation and is shown on the plans to be internally lined, the exterior insulation thickness may be reduced by the thickness of the lining. Where exterior insulation can be eliminated or reduced due to thickness of lining, overlap exterior insulation a minimum 24 inches over lined ductwork.

F. Where canvas jacketing is indicated, apply mastic in sufficient thickness to completely cover the texture of the canvas material.

3.07 SCHEDULE - DUCTWORK

DUCTWORK	TYPE	INSULATION THICKNESS	FINISH
Combustion Air Duct	L	2" Rigid	CANVAS
Exhaust & Relief Ducts Within 10 ft. of Exterior Openings	K	1"	FSK
Outside Air Intake Ducts	L	2" Rigid	CANVAS
Plenums	N	1"	
Supply Ducts	K	1"	FSK
Return and Relief Ducts in Mechanical Rooms	K	1" Rigid	CANVAS
Internal Acoustic Lining	N	1"	

END OF SECTION

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SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes Cx process requirements for the following HVAC systems, assemblies, and equipment modified as part of this project:

1. Energy supply systems.
2. Heat generation systems.
3. Cooling generation systems.
4. Central-station air-handling systems.
5. Air, steam, and hydronic distribution systems.
6. Heating and cooling terminal and unitary equipment.
7. HVAC controls.
8. TAB verification.

B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
2. For construction checklists, comply with requirements in various Division 23 Sections specifying HVAC systems, system components, equipment, and products.

1.02 DEFINITIONS

A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."

B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."

C. DDC: Direct digital controls.

D. HVAC: Heating, ventilating, and air conditioning.

E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

F. TAB: Testing, adjusting, and balancing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREFUNCTIONAL CHECKLIST REVIEW

A. Review and provide written comments on draft prefunctional checklists. CxA will create required draft construction checklists and provide them to Contractor.

B. Return draft prefunctional checklist review comments within 5 days of receipt.

C. When review comments have been resolved, the CxA will provide final prefunctional checklists, marked "Approved for Use, (date)."

D. Use only construction checklists, marked "Approved for Use, (date)."

3.02 CX TESTING PREPARATION

A. Certify that HVAC systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved submittals.

B. Certify that HVAC instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.03 CX TEST CONDITIONS

A. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.

3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

B. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.04 CX TESTS COMMON TO HVAC SYSTEMS

A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.

B. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response according to acceptance criteria.

C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.

D. Comply with prefunctional checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Division 23 Sections specifying HVAC systems and equipment.

E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:

1. Prefunctional checklist verification tests.
2. Prefunctional checklist verification test demonstrations.
3. Cx tests.
4. Cx test demonstrations.

F. Vibration Isolation in HVAC Systems:

1. Prerequisites: Acceptance of results of prefunctional checklists for vibration and seismic control devices specified in Section 200548 "Vibration and Seismic Control."
2. Components to Be Tested:
   a. Vibration isolation and seismic control devices in mechanical systems.
   b. Structural systems.
3. Test Purpose: Evaluate effectiveness of vibration isolation and seismic control devices.

4. Test Conditions: Measure vibration of the facility structure at [**three**] locations designated by Owner's witness while the isolated equipment operates.

5. Test Conditions: Measure vibration of the facility structure at [**three**] locations designated by Owner's witness at the following operating conditions:

   a. Maximum speed.

   b. Minimum speed.

   c. Critical speed.

6. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.

3.05 TAB VERIFICATION

A. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

B. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

C. Scope: HVAC air systems and hydronic piping systems.

D. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.

E. Conditions of the Test:

   1. Cx Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

   2. Systems operating in full heating mode.

   3. Systems operating in full cooling mode.

   4. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.

F. Acceptance Criteria:

   1. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

   2. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than the tolerances allowed.

3. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

3.06 HEATING CONTROL SYSTEM CX TESTS

A. Heating-Water Supply Temperature Control:

1. Prerequisites: Installation verification of the following:

a. Startup of boilers BLR-XX and BLR-XX and boiler circulation pumps PMP-XX and PMP-XX.

b. Startup of heating-water pump(s) PMP-XX and PMP-XX.

c. TAB of heating-water flow and pressure.

d. Input Device: Heating-water supply temperature; temperature transmitter.

e. Output Device: Control valve .

f. Display the following at the operator's workstation:

1) Heating-water supply temperature.

2) Heating-water supply temperature set point.

3) Control-valve position.

4) Pump speed as a percentage

2. Scope: Heating-water system.

3. Purpose: Control of heating-water supply temperature at input device temperature transmitter.

4. Conditions of the Test:

a. Minimum heating-water flow; Pump speed at minimum 35%.

b. Midrange Heating-Water Flow: 60 to 70 percent of maximum.

c. Maximum heating-water flow; Pump speed at 100%.

5. Acceptance Criteria: Under all conditions, heating-water supply temperature is within plus or minus **2.0 deg F** of set point.

B. Heating-Water Supply Temperature Reset:

1. Prerequisites: Installation verification of the following:

a. Startup of boilers BLR-XX and BLR-XX and boiler circulation pumps PMP-XX and PMP-XX.

b. Startup of heating-water pump(s) PMP-XX.

c. TAB of heating-water flow and pressure.

d. Input Device: Heating-water supply temperature; temperature transmitter.

e. Input Device: Outdoor-air temperature; [electric, outdoor-air-reset controller.

f. Output Device: Control valve <**Insert device designation**>.

g. Display the following at the operator's workstation:

1) Outdoor-air temperature.

2) Heating-water supply temperature.

3) Heating-water supply temperature set point.

4) Control-valve position.

5) Pump speed as a percentage

2. Scope: Heating-water system.

3. Purpose: Control of heating-water supply temperature at heating-water supply temperature input device temperature transmitter in response to variable outdoor-air temperature input; electric, outdoor-air-reset controller.

4. Conditions of the Test: Outdoor-air temperature input value may be overridden for this test.

a. Low Temperature: Outdoor-air temperature between 0 deg F and 60 deg F.

b. High Temperature: Outdoor-air temperature above 60 deg F .

5. Acceptance Criteria: Heating-water supply temperature resets in straight-line relationship with outdoor-air temperature for the following reset schedule. Under all conditions, heating-water supply temperature is within 2.0 deg F of set point.

a. 190 deg F heating water when outdoor-air temperature is 0 deg F .

b. 140 deg F heating water when outdoor-air temperature is 60 deg F.

c. Under all conditions, heating-water supply temperature is within plus or minus 2.0 deg F of set point.

C. Control Primary Circulating Pump(s):

1. Prerequisites: Installation verification of the following:

a. Startup of heating-water pump(s) PMP-XX, PMP-XX.

b. Input Device: Outdoor-air temperature; electric, outdoor-air-reset controller

c. Output Device: Heating-water pump; DDC system command to starter relay.

d. Display the following at the operator's workstation:

1) Outdoor-air temperature.

2) Operating status of primary circulating pump(s).

3) Operating speed of primary circulation pump(s) as a percentage.

2. Scope: Heating-water pump(s) PMP-XX, PMP-XX and associated controls.

3. Purpose: On-off control of heating-water pump(s) in response to variable outdoor-air temperature input; electric, outdoor-air-reset controller.

4. Conditions of the Test:

a. High Temperature: Outdoor-air temperature above 60 deg F.

b. Low Temperature: Outdoor-air temperature below 60 deg F.

5. Acceptance Criteria:

a. High Temperature: Pump(s) are off when outside-air temperature is above 60 deg F.

b. Low Temperature: Pump(s) are on when outside-air temperature is below 60 deg F.

3.07 AIR-HANDLING SYSTEM CX TESTS AHU-X

A. Supply Fan(s) Variable-Volume Control:

1. Prerequisites: Installation verification of the following:

a. Volume Control Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to conditioned-space static pressure.

b. Volume Control Output Device: DDC system analog output to motor speed controller. Set mixing box outside air damper to closed position when fan is stopped.

c. Volume Control Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to conditioned-space static pressure.

d. Volume Control Output Device: DDC system analog output to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.

e. High-Pressure Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.

f. High-Pressure Output Device: DDC system binary output to alarm panel.

g. Display the following at the operator's workstation:

1) Supply-fan-discharge static-pressure indication.

2) Supply-fan-discharge static-pressure set point.

3) Supply-fan airflow rate.

4) Supply-fan speed.

5) Supply-fan mixing box outside air damper position.

2. Scope: VAV supply fan units and associated controls.

3. Purpose:

a. Supply-air discharge static pressure control.

b. Response to excess supply-air discharge static pressure condition.

4. Conditions of the Test:

a. Minimum supply-air flow.

b. Midrange Supply-Air Flow: 50 to 60percent of maximum.

c. Maximum supply-air flow.

d. Excess supply-air discharge static pressure.

5. Acceptance Criteria:

a. At all supply-air flow rates, and during changes in supply-air flow, discharge air static pressure is at set point plus or minus 2 percent.

b. Fan stops and an alarm is initiated at the operator's workstation when supply-air discharge static pressure is at the excess static pressure, plus or minus 2 percent.

B. Air-Handler Mixed-Air Control:

1. Prerequisites: Installation verification of the following:

a. Minimum Position Input Device: DDC system time schedule.

b. Output Device: DDC system analog output to modulating damper actuator(s).

c. Heating Reset Input Device: DDC system software.

d. Supply-Air Temperature Input Device: Electronic temperature sensor.

e. Cooling Reset Input Device: Outdoor- and return-air, duct-mounted electronic temperature sensors.

f. Display the following at the operator's workstation:

1) Supply-air-temperature indication.

2) Supply-air-temperature set point.

3) Mixed-air damper position.

2. Scope: Air handler with mixed-air control and associated controls.

3. Purpose:

a. Occupied time control.

b. Minimum damper position control.

c. Heating reset control.

d. Supply-air temperature control.

e. Cooling reset control.

f. Unoccupied time control.

4. Conditions of the Test:

a. Occupied Time Control: Start in unoccupied schedule. Advance to occupied schedule time.

b. Minimum Damper Position Control: Command system to mode in which minimum damper position is required.

c. Heating Reset Control: Create a call for heating.

d. Supply-Air Temperature Control: Override [**supply**] [**mixed**]-air temperature set point to a value **2.0 deg F** above current supply-air temperature.

e. Cooling Reset Control: Override outdoor-air temperature to a value that exceeds return-air temperature.

f. Unoccupied Time Control: Advance to unoccupied schedule time.

g. Control Data Trend Log: Set up a data trend log of the following input device values and output device commands. Record data at hourly intervals. Submit trend data for 24-hourperiods in which natural conditions require heating reset control, supply-air temperature control, and cooling reset control.

1) Minimum position input device.

2) Heating reset input device.

3) Supply-air temperature input device.

4) Cooling reset input device.

5. Acceptance Criteria:

a. Occupied Time Control: Mixed-air control is active in occupied mode.

b. Minimum Damper Position Control: Controller positions outdoor-air dampers to minimum position.

c. Heating Reset Control: Controller sets outdoor-air dampers to minimum position.

d. Supply-Air Temperature Control: Controller modulates outdoor-, return-, and relief-air dampers to maintain temporary supply-air temperature set point, plus or minus 1.0 deg F.

e. Cooling Reset Control: Controller sets outdoor-air dampers to minimum position when outdoor-air temperature exceeds return-air temperature

f. Unoccupied Time Control: Controller positions outdoor- and relief-air dampers closed and return-air dampers open.

g. Control Data Trend Log: Data verify control according to sequence of control.

3.08 GENERAL EXHAUST FAN CX TESTS

A. Exhaust Fan Flow Control

1. Prerequisites: Installation Verification of the following:

a. Motor operated backdraft dampers

b. Connection to associated AHU

2. Scope: Building general exhaust fans
3. Purpose:
    a. System start up
    b. Occupied operation
    c. Full shutdown
4. Conditions of the test:
    a. AHU occupied coordinated control: start from full shutdown. Advance to occupied schedule time.
    b. AHU Unoccupied coordinated control: Advance coordinated AHU to unoccupied scheduled time.
5. Acceptance criteria:
    a. AHU occupied coordinated control: controller positions motor operated backdraft dampers open and associated exhaust fan energizes.
    b. AHU unoccupied coordinated control: exhaust fan de-energizes and controller positions motor operated backdraft dampers closed.

3.09 HYDRONIC CHILLED WATER COOLING SYSTEM CX TESTS

A. Hydronic Chilled Water Cooling System

1. Prerequisites: Installation Verification of the following:
    a. Temperature Control Input Device: Cooling loop temperature sensor.
    b. Ambient Temperature Control Input Device: Outdoor ambient temperature sensor
    c. Primary Chilled water cooling loop circulator pumps PMP-9A and PMP-9B
    d. Secondary Building cooling loop circulator pumps PMP-10A and PMP-10B
2. Scope: Hydronic Chilled Water Cooling System
3. Purpose:
    a. System Startup
    b. Low Demand Control
    c. High Demand Control

d. Standby chiller startup Control

e. Decreases in Cooling System Demand

f. Freeze Protection Control

g. System Shutdown

4. Conditions of Test:

a. System Startup: Start system from full shutdown.

b. Observe enabling of C-1 (lead) and PMP-9A and PMP-10A initial start up and run for 5 mins for temperature equalization.

c. Low Demand Control: Slowly increase demand across the building cooling valves. Observe single pump operation

d. High Demand Control: Increase demand across the building cooling valves and observe staging on of secondary pumps and chiller.

e. Observe Standby chiller startup control sequence.

f. Decreases in Cooling System Demand: Reduce the cooling demand, and observe staging off of pumps and chiller

g. Freeze Protection Control: Induce low ambient temperature operation and observe pump operation in low temperature condition.

h. System Shutdown: Initiate full cooling system shutdown.

5. Acceptance Criteria:

a. System Startup: System starts primary pumps PMP-9A and PMP-10A and enables chiller.

b. Observe the operation of PMP-10A modulating to maintain 15 PSI system pressure and PMP-9A operation at constant GPM flow rate. After 5 min equalization is complete C-1 is started.

c. Supply temperature is maintained between 42 and 45 deg F, maintaining critical control valve between 80 and 90% open. System continues to operate on PMP-10A until 95% pump speed is hit.

d. PMP-10A reaches 95% and then is reduced to 50% pump speed and PMP-10B is started first at minimum speed and ramped up to 50%. Then both pumps modulate in parallel to loop differential pressure set point.

e. As C-1 is not able to meet primary cooling loop glycol supply temperature, chiller C-2 is enabled by the BAS. Chiller C-1 is reduced to 66% to enable standby chiller stage on. PMP-9B is started and constant speed. Chiller C-2 is run on packaged controls, to BAS set point. C-1 Demand limit is released after 5 minutes and C-1 and C-2 operate to maintain secondary building cooling loop setpoint.

f. Decreases in Cooling System Demand: Observe staging down of cooling system equipment while maintaining cooling system setpoint.

g. Freeze Protection Control: PMP-9A and PMP-9B operate at minimum speed to circulate glycol through the chillers and start lead secondary chilled glycol loop circulator.

h. All equipment should disable and shut off.

3.10 SIDEWALK SNOWMELT SYSTEM CX TESTS

A. Snowmelt System Temperature Control

1. Prerequisites: Installation Verification of the following:

a. Temperature Control Input Device: Slab Temperature Sensor

b. Temperature Control Output Device: 3-way control valve actuator

c. Heating Glycol System and Snowmelt system startup

d. Snowmelt System Circulation Pump PMP-8

e. Snowmelt System Heat Exchanger HX-2

f. Snowmelt System Controller

g. Precipitation Sensor

2. Scope: Sidewalk Snowmelt System and associated controls

3. Purpose:

a. System startup

b. Idle temperature control

c. Melt cycle temperature control

d. Warm weather cutoff control

e. Runtime control

f. Alarm monitoring

4. Conditions of the Test

    a. Warm Weather Cutoff Control: Start above warm weather cutoff. Drop to below warm weather cutoff.

    b. Observe snowmelt pumps start and 3-way valves modulate to maintain idle setpoint temperature of 25 deg F.

    c. Initiate melt cycle to control slab temperature at warm weather cutoff setpoint

    d. Maintain warm weather cutoff setpoint until no moisture is present

    e. Maintain warm weather cutoff setpoint until elapsed runtime exceeds setpoint

    f. Generate alarm if system is unable to achieve warm weather cutoff setpoint in 24 hours.

    g. Monitor run and alarm status

5. Acceptance Criteria:

    a. Warm weather cutoff setpoint energizes snowmelt system pumps and 3-way control valve actuator.

    b. Snowmelt system pumps and 3-way control valve actuator maintains idle temperature setpoint.

    c. Melt cycle initiates slab temperature setpoint to warm weather cutoff setpoint of 38 deg F.

    d. Warm weather cutoff setpoint is maintained until no moisture is present

    e. Warm weather cutoff setpoint is maintained until elapsed runtime exceeds setpoint

    f. Alarm is generated if system is unable to achieve warm weather cutoff setpoint within time setpoint.

END OF SECTION 23 08 00

SECTION 23 09 23 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

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

B. Furnish a native BACnet-based Building Automation System (BAS), including an operator's workstation using Microsoft as the operating system and shall be based on a distributed control system in accordance with this specification. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135, BACnet.

C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.

D. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

E. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.

F. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.

G. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

H. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.

I. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.

J. Provide supervisory specialists and technicians at the job site to assist in system startup, and commissioning.

K. Provide a comprehensive operator and technician training program as described herein.

L. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

M. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

1.02 SYSTEM DESCRIPTION

A. Distributed logic control systems complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as pumps, air handlers, heat exchangers, etc. and any other listed equipment using native BACnet-compliant components.

B. Operator's workstation software shall be Microsoft as the computer operating system. The Building Management System (BAS) application program shall be written to communicate specifically utilizing BACnet protocols. Software shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, full suite of field engineering tools including graphical programming and applications.

C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage. All application controllers all equipment and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.

D. Controllers shall be fully programmable, BACnet Advanced Application Controllers (B-AAC) or higher, tested and listed by BTL. Controllers shall support onboard scheduling, alarming, trending, and time-based control independent of the operator workstation.

E. Room sensors shall allow room setpoint adjustment within preset limits. Initial settings 68-72 Degrees F.

F. Provide all alarms, manual control, and status indication functions as indicated under the sequence of operation, Specification Section 23 09 93.

G. The system shall be Web Enabled and shall be accessible through any computer connected to the internet using a standard web browser and appropriate password protection. Contractor shall include costs for all network wiring and coordination with the owner for IP Address connection.

H. The system shall include remote notification services to allow messaging of critical alarms to owners' designated personnel and to the central alarm facility.

I. The DDC system shall be hosted on the existing Central Server. Coordinate with Owner for integration and hosting requirements on existing central server.

J. BACnet/IP communications shall be limited to building-level controllers, advanced application controllers, and operator workstations unless otherwise approved by the Engineer. Application controllers and terminal unit controllers shall communicate via BACnet MS/TP unless otherwise indicated or approved.

1.03 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results For HVAC.

B. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

C. Section 23 21 13 - Hydronic Piping.

D. Section 23 21 16 - Hydronic Specialties.

E. Section 23 33 00 - Air Duct Accessories.

F. Section 23 36 00 - Air Terminal Units.

G. Division 26 - Electrical Specifications

1.04 REFERENCES

A. ANSI/ASHRAE 135, BACNET - A Data Communication Protocol for Building Automation and Control Networks (BACnet).

1.05 QUALITY ASSURANCE

A. The direct digital control system provided shall be designed, furnished, installed, tested, certified and placed into service by a Control Contractor who is regularly engaged in the installation of direct digital control systems in Alaska. The Control Contractor shall maintain an office in Alaska with parts and maintenance personnel to ensure prompt response (24 hour maximum) to an emergency call during the one year correction period.

B. The Control Contractor shall be able to demonstrate that he has had experience designing and installing direct digital control systems of comparable type and size to that called for in these Specifications.

C. The Control Contractor, if other than the manufacturer, shall hold a manufacturer's franchise or license to design and install control systems for that manufacturer.

D. Within two weeks after award of contract submit to the Project Manager the following items for Contractor qualification:

1. Name of manufacturer and proof that the Control Contractor holds a manufacturer's franchise or license to design and install the proposed control system.

2. Proof of Alaskan Office, with full time service representative.

3. List of Alaskan buildings with names, addresses, and phone numbers of Owners which are representative of direct digital control systems that have been installed by the Control Contractor. Include a brief description and approximate control system construction cost of each system submitted.

4. Provide verification that each and every controller, sensor, and all other BAS components shall be individually tested and listed by the BACnet Testing Laboratories (BTL).

1.06 CONTROLLER PERFORMANCE AND CAPABILITY REQUIREMENTS

A. All Direct Digital Controllers (DDC) provided under this Section shall be native BACnet devices, tested and listed by BACnet Testing Laboratories (BTL) and certified as BACnet Advanced Application Controllers (B-AAC) or higher.

B. Controllers shall be **fully programmable** and capable of executing all control sequences described in the Contract Documents without reliance on the operator workstation.

C. Each controller shall support the following functions **resident within the controller**:

1. Scheduling

2. Alarm generation and storage

3. Trend logging

4. Time-based control

5. Standalone operation during loss of network communication

D. Loss of communication with the operator workstation or network engine shall **not impair the continued operation** of controlled equipment.

1.07 EQUIPMENT AND SHOP DRAWING REVIEW SUBMITTALS

A. Provide electronic submittals in accordance with Section 23 05 00 and Division 01.

B. Prior to programming, ordering of equipment, or installation of any portion of the system submit the following in a single tabbed and indexed PDF package for review by the Project Manager. The shop drawings shall include an electronic bookmark for every major system initial sheet. Shop drawings without bookmarks will be rejected without review for correction.

1. System architecture diagram showing power supply to each component; interconnection of direct digital controllers, building management station, and peripherals; and indication of proposed location of direct digital controllers.

2. Sequence of operations. Print sequence of operations on the schematic control diagrams so that the relevant sequence is on the same diagram with the control schematic it describes. The Sequence of Operations provided in the Contract Documents is written in directive language. Rewrite the sequence of operations to be submitted to the Owner in language that explains the sequences of operation. Remove all directives to the Contractor.

3. Schematic control diagrams 11 inches by 17 inches minimum paper size with upper case lettering, minimum 1/16 inch high plotted from digitized files in AutoCAD format. Clearly indicate wire and terminal labels, set points, reset schedules, switch over points, signal ranges, and other points required to completely describe the system. Show interface with any existing control systems. Depict circuitry on schematic control diagrams to allow circuits to be traced from connection to connection using one of the following methods:

    a. Diagram each wire or tube depicting full length of circuit from connection to connection.

    b. Reference each wire to a uniquely labeled terminal. Depict terminals on a sequentially labeled terminal strip showing attached wires and the device labels of the components attached at the other end. If the wiring label used is different than the terminal label indicate the wire label. In addition provide ladder diagrams indicating current or air flow through circuitry components.

    c. Construct digitized schematic control diagrams using a symbol library so that symbols for similar equipment are common. Use separate layers or line type designations for the following items:

        1) Device Symbols.

        2) Equipment Symbols.

        3) Ductwork.

        4) Piping.

        5) Wiring.

4. Valve schedules.

5. Control Wiring Floor Plans. Provide architectural floor plans overlaid with control components. Plans shall include locations of sensors, valves, dampers, transformers, control cabinets, mechanical and electrical equipment interlocked or controlled by BAS, and communication and power wiring.

6. Subpanel and panel face layouts.

7. Control components data sheets, installation, operation, and adjustment instructions. Further index and tab this section of the submittal by item number.

    a. Each control component shall be identified with a separate item number. Separate each item with a divider sheet with plastic index tabs.

    b. Provide two alphabetical listings of all items included in the binder in an index at the front of the binder. One index shall list items by functional name. The other index shall list items by symbol used in the control diagrams.

c. Each sheet or page shall indicate the specific item(s) proposed for this project. Delete or cross out all other items.

d. For all system elements operator's workstation(s), building controller(s), application controllers, routers, and repeaters, provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135.

e. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.

8. Orientation and training instruction schedule and course outlines.

9. Control Transformer Schedule. Provide control transformer schedule indicating tag id, location, equipment serviced, and VA consumed. Transformers shall be UL listed, class 2 power limited, provide built in circuit breaker and have a minimum of 15% spare capacity.

1.08 OPERATION AND MAINTENANCE MANUALS

A. Provide electronic operations and maintenance manuals in accordance with Section 23 05 00 and Division 01 Standard General Provisions.

B. Operation and Maintenance Manuals must be submitted for review, reviewed by the Project Manager, corrected in accordance with review comments, and accepted by the Project Manager before a request for final or substantial completion inspection will be considered by the Project Manager.

C. The Operation and Maintenance Manual shall include the information required for the equipment review submittal, updated as required to reflect current as-built conditions, plus the following:

1. A brief customized guide to system operation prepared for the proprietary programming and interfacing software. Include copies of the guide in the Operation and Maintenance Manual, laminated between two plastic sheets for use away from the workstations. The guide shall include:

a. Log on procedure.

b. Procedure for accessing interactive video display screens, changing set points, acknowledging alarms, creating history logs, and reviewing history logs.

c. Instructions for backing up the building management system and start up the system after a computer failure.

d. Instructions for backing up individual direct digital controllers and start them up after a controller failure.

2. Maintenance information and parts lists for control components.

3. Complete system as-built wiring diagrams indicating the following:

a. Wiring for all control and power circuits indicating the voltage and breaker location for each circuit.

b. Wiring for direct digital controllers and interface panels.

c. Terminal number or code name for terminals in direct digital controllers and interface panels with unused terminals marked "spare".

d. Assigned name, address, and engineering units for direct digital controller input and output terminals.

4. Control Wiring Floor Plans field generated red-lines. Provide architectural floor plans overlaid with control components and their installed locations. Plans shall include locations of sensors, valves, dampers, transformers, control cabinets, mechanical and electrical equipment interlocked or controlled by BAS, and communication and power wiring routing.

5. Control Transformer Schedule. Provide control transformer schedule indicating tag id, location, equipment serviced, and VA consumed.

6. Valve Schedule.

7. List of software with current revision numbers, vendor name and support telephone numbers.

8. Include copies of programming and variable printouts for the direct digital control logic created to fulfill the sequence of operation requirements. Include the following information:

a. Print the sequence of operation corresponding to the program listing on that page.

b. Block Programming diagrams if block programming is used.

9. Provide backup copy of programming and graphics for the direct digital control system with instructions on how to install the backup software if the system needs to be re-installed. Provide on USB drive.

10. Provide digitized copies of O & Ms, as built schematic control diagrams, wiring diagrams, and graphic screens recorded on USB drive in PDF drawing format.

11. Provide a print out of the configuration files for each controller. Place controller specific print out in specific controller cabinet.

12. Provide other information required for the Owner to properly troubleshoot and maintain the control system.

D. Published and bound building management system software or hardware manuals are not required to be included in the three ring “Operation and Maintenance Manual”. Provide one digital copy of each published building management system software or hardware manual

required for the maintenance and operation of building management system to the Project Manager one week prior to request for substantial completion. Provide a separate index sheet describing each separate manual as part of the “Operation and Maintenance Manual”.

E. Provide editing facilities used in the developing of the building management system so that any custom programming required to apply the building management system to this project is accessible to a trained operator for viewing, editing, or creating similar software structures. List software that cannot be changed by the operator with model and version number. Any custom software is considered the property of the owner with full right to copy. This software is required to work across the BACNET/IP network.

F. After the final inspection and subsequent punch list inspections update each copy of the Operation and Maintenance Manual to reflect final as-built conditions.

1.09 SYSTEMS DEMONSTRATION

A. The Contractor will completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operation.

B. Provide complete demonstration of system operation to the owners representative at the project substantial completion inspection. The Contactor will demonstrate to the Owner's satisfaction that all equipment and systems operate in accordance with the sequence of operation as outlined under Section 23 09 93. Demonstration will include all equipment controlled by the Direct Digital Control System.

C. Building management station demonstration will consist of:

1. Running sample point log and system configuration reports as requested.

2. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.

3. Step through penetration tree, display all graphics, demonstrate dynamic update and direct access to graphics.

4. Execute system commands in graphic mode including operation of control system set points, schedules, valves, dampers and control relays. Commands shall be executed as necessary to demonstrate the system is controlling in accordance with the sequence of operations.

5. Demonstrate update, and alarm responsiveness.

6. Demonstrate digital system configuration graphics with interactive upload and download, and demonstrate specified diagnostics.

1.10 WARRANTY

A. Under provisions of Division 01 Standard General Provisions.

B. All components, system software, parts and assemblies will be guaranteed against defects in materials and workmanship for one year from acceptance date.

C. Labor to troubleshoot, repair, reprogram, or replace system components will be furnished by the Contractor at no charge to the owner during the warranty period.

D. All corrective software modifications made during warranty service periods will be updated on user documentation and on user and manufacturer archived software.

1.11 SUBSTANTIAL INSPECTION SUPPLEMENTAL DATA

A. Substantial inspection supplemental data must be submitted for review, reviewed by the Project Manager, corrected in accordance with review comments, and accepted by the Project Manager before a request for substantial completion inspection will be considered by the Project Manager.

PART 2 PRODUCTS

2.01 APPROVED BUILDING AUTOMATION SYSTEMS

A. Metasys.

B. No Substitutions.

2.02 OPERATOR'S WORKSTATION

A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive.

B. BACnet Conformance:

1. Operator's workstation shall support Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device. Operator's terminal shall support all BACnet services necessary to provide the following BACnet functional groups.

    a. Clock Functional Group.

    b. Event Response Functional Group.

    c. Time Master Functional Group.

    d. Device Communications.

2. Please refer BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

4. The Operator Workstation shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

5. Displays:

    a. Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD™ or Visio™ drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.

    b. All displays and programming shall be generated and customized by the local EMCS supplier and installer.

    c. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse a graphic of a switch or light, for example, which then displays a different graphic (such as an "ON" switch or lighted lamp). Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example: when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the

graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click on an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

d. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the "increase" or "decrease" arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.

e. Analog objects may also be assigned to an area of a system graphic, where the color of the defined area changes based on the analog object's value. For example, an area of a floor-plan graphic served by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. All editing and area assignment shall be created or modified online using simple icon tools.

f. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label push buttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

g. A mouse shall be used to move the pointer arrow to the desired item for selection of new display or to allow the operator to make changes to object data.

6. Password Protection:

a. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.

b. Each operator's terminal shall provide security for 200 users minimum. Each user shall have an individual User ID, User Name and Password. Entries are alphanumeric

characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions and menu items to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Each user shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.

c. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.

7. Operator Activity Log:

a. Operator Activity Log shall be included with system that tracks all operator changes and activities. System shall track what is changed in the system, who performed this change, date and time of system activity and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation.

b. Log shall be gathered and archived to hard drive on operator workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.

c. Any displayed data, that is changeable by the operator, may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

8. Scheduling:

a. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily with events being the highest.

b. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.

c. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting Schedule.

d. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated

based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.

9. Alarm Indication and Handling:

   a. Operator's workstation shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s), currently running. Printout of alarms shall be sent to the assigned terminal and port.

   b. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment and identification of operator acknowledging alarm.

   c. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the operator's terminal or via remote communication.

   d. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting alarm setup.

10. Trendlog Information:

   a. System server shall periodically gather historically recorded data stored in the building controllers and archive the information Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's workstation. Operator shall be able to scroll through all trended data. All trendlog information shall be displayed in standard engineering units.

   b. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x,y) graphs that display up to ten object types at the same time in different colors. Graphs shall show object values relative to time.

   c. Operator shall be able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.

d. System shall include a trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.

11. Energy Log Information:

a. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.

b. All data shall be stored in data base file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.

c. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.

d. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format the user shall be able to select a specific period of data to view.

12. Demand Limiting:

a. System shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.

b. Binary shedding shall include minimum of 5 priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one the loads shall be shed/restored in a "first off-first on" mode and in the other the loads are just shed/restored in a linear fashion.

c. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.

d. Status of each and every load shed program shall be capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

13. Configuration/Setup:

    a. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

14. Field Engineering Tools:

    a. Operator's workstation software shall include field-engineering tools for programming all controllers supplied.

    b. Programming tools shall include a real time operation mode. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

    c. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled.

    d. Field engineering tool shall include Device Manager for automatic detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive.

    e. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media.

C. At the conclusion of project, contractor shall leave with owner a USB drive that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

2.03 GENERAL PURPOSE EQUIPMENT CONTROLLERS

A. Provide native BACnet General Purpose Equipment Controllers for control of mechanical systems including, but not limited to, air handling units, pumps, heat exchangers, packaged equipment, and miscellaneous HVAC systems.

B. Controllers shall communicate using BACnet MS/TP unless otherwise indicated or approved and shall comply with ANSI/ASHRAE Standard 135.

C. Controllers shall include the following minimum capabilities:

1. Programming and Control:
    a. Fully programmable, user-defined logic.
    b. Proportional-Integral (PI) or PID control algorithms.
    c. Adaptive tuning to automatically optimize control loop performance.
    d. Ability to execute complex control sequences involving both directly wired I/O and networked BACnet devices.
2. Input / Output
    a. Universal Inputs configurable as:
        1) 0–10 VDC.
        2) 4–20 mA.
        3) Resistance (thermistors or RTDs).
        4) Dry contact binary input.
    b. Binary Outputs rated for 24 VAC control.
    c. Analog Outputs configurable for:
        1) 0-10 VDC.
        2) 4-20 mA.
3. Local Functions
    a. Integral real-time clock.
    b. Non-volatile memory to retain programming, trends, alarms, and setpoints.
    c. Local scheduling, alarming, and trend logging independent of network connection.
4. Networking
    a. Support for BACnet MS/TP trunking.
    b. Support a minimum of 100 devices per trunk.
    c. Maximum MS/TP segment length of 15,000 feet
5. Maintenance and Diagnostics
    a. Status indication LEDs for power, communication, and fault conditions.
    b. Firmware shall be upgradeable remotely over the BACnet network.

c. Ability to upload and download application programs and firmware.

2.04 VARIABLE AIR VOLUME (VAV) TERMINAL UNIT CONTROLLERS

A. Provide one native BACnet VAV Terminal Unit Controller for each VAV box.

B. Controllers shall be pressure-independent and capable of maintaining airflow setpoints regardless of upstream duct pressure variations.

C. Controllers shall include the following minimum features:

1. Airflow Measurement and Control

a. Integral differential pressure sensor.

b. Automatic airflow calibration.

c. Automatic correction for high- and low-pressure tubing polarity.

d. Capability to revert to pressure-dependent control if airflow signal becomes unreliable.

2. Control Performance

a. PI control algorithm for space temperature and airflow control.

b. Adaptive tuning to optimize damper response and reduce commissioning effort.

c. Fast-response damper actuator capable of full stroke in 90 seconds or less.

3. Energy Code Compliance

a. Control logic preventing simultaneous heating and cooling.

b. Compliance with ASHRAE Standard 90.1.

c. Automatic reset of airflow during reheat sequences.

4. Diagnostics

a. Onboard fault detection including:

1) Starved box.

2) Actuator stall.

3) Insufficient airflow.

4) Unreliable space temperature sensor.

b. Diagnostic information available through the BAS without additional tools.

5. Fail-Safe Operation

    a. Control setpoints stored in non-volatile memory.

    b. Continued operation during network or supervisory controller failure.

D. Adaptive tuning shall not preclude manual adjustment by authorized personnel.

2.05 ADVANCED APPLICATION / FIELD CONTROLLERS

A. Where required by system complexity or point count, provide Advanced Application Controllers capable of global and plant-level control strategies.

B. Controllers shall be capable of:

1. Managing multiple control loops simultaneously

2. Executing global control logic using inputs from any BACnet device on the network

3. Coordinating sequencing, staging, and optimization of multiple pieces of equipment

C. Controllers shall support BACnet MS/TP and BACnet/IP communications and shall function as native BACnet routing devices where required.

D. Controllers shall include sufficient onboard memory and processing power to execute all control strategies without reliance on the operator workstation.

2.06 CENTRAL PLANT CONTROL

A. Where central heating or cooling plants are provided, the BAS shall include integrated control strategies for plant equipment including chillers, boilers, pumps, cooling towers, and heat exchangers. All plant-level sequencing shall reside in the designated plant or building controller.

B. Plant control shall include:

1. Equipment staging and sequencing

2. Lead/lag rotation

3. Interlocks and safeties

4. Optimization based on system demand and operating conditions

C. Control strategies shall be fully programmable and modifiable through the BAS without firmware changes.

2.07 BUILDING CONTROLLER

A. General:

1. All communication with operator workstation and all application controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way

BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) master slave token passing (MS/TP) LANs, a point-to-point (PTP - RS-232) connection and modem.

a. Each MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.

b. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).

c. The direct access port must be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.

2. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.

3. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.

4. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.

5. Controller shall have a memory needed to ensure high performance and data reliability.

6. Global control algorithms and automated control functions should execute via 32-bit processor.

7. Controller installation shall include memory-free gel-cell battery providing ongoing power conditioning and noise filtering for operation data integrity. It shall provide up to 5 minutes of powerless operation for orderly shutdown and data backup.

B. BACnet Conformance:

1. Building Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall support all BACnet services necessary to provide the following BACnet functional groups:

a. Clock Functional Group.

b. Files Functional Group.

c. Reinitialize Functional Group.

d. Device Communications Functional Group.

e. Event Initiation Functional Group.

2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

4. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. Schedules:

1. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.

D. Logging Capabilities:

1. Each building controller shall log a minimum of 1000 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.

2. Logs may be viewed both on-site or off-site via remote communication.

3. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.

4. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

E. Alarm Generation:

1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.

2. Each alarm may be dialed out as noted in paragraph 2 above.

3. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.

4. Controller must be able to handle up to 1500 alarm setups stored as BACnet event enrollment objects - system destination and actions individually configurable.

2.08 APPLICATION CONTROLLERS

A. Provide one or more native BACnet application controllers for each mechanical system and provide native BACnet application controllers as needed for control that adequately cover all objects listed in object list. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.

B. BACnet Conformance:

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Application controllers shall support all BACnet services necessary to provide the following BACnet functional groups:

   a. Files Functional Group.

   b. Reinitialize Functional Group.

   c. Device Communications Functional Group.

2. Please refer to BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include as a minimum-Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

4. Application controllers shall include universal inputs with 10-bit resolution that accept thermistors or RTDs, 0-10VDC, 0-5 VDC, 4-20 mA and dry contact signals. Any input on a controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller may include binary and analog outputs on board. Analog outputs shall be

switch selectable as either 0-10VDC or 0-20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.

5. All program sequences shall be stored on board application controller in EEPROM nonvolatile flash memory. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

6. Application controller shall include support for intelligent room sensor. Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.09 EXPANDABLE APPLICATION CONTROLLERS

A. General:

1. Expandable application controller shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.

2. Controller shall support additional Analog and Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.

3. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's terminal or field computer.

4. Controller shall have adequate data storage to ensure high performance and data reliability.

5. Global control algorithms and automated control functions should execute via 32-bit processor.

6. Controller shall include both on-board 10BASE-T/100BASE-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.

7. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support thermistors or RTDs, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.

8. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.

9. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Controller shall provide up to 176 discreet inputs/outputs per base unit.

B. BACnet Conformance:

1. Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall support all BACnet services necessary to provide the following BACnet functional groups:

   a. Clock Functional Group.

   b. Files Functional Group.

   c. Reinitialize Functional Group.

   d. Device Communications Functional Group.

   e. Event Initiation Functional Group.

2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.

4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internet work, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must

support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. Schedules:

1. Each controller shall support a minimum of 50 BACnet Schedule Objects.

D. Logging Capabilities:

1. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.

2. Controller shall periodically upload trended data to system server for long term archiving if desired.

3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

E. Alarm Generation:

1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.

2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.

3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects - system destination and actions individually configurable.

2.10 TERMINAL UNIT APPLICATION CONTROLLERS

A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance:

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall support all BACnet services necessary to provide the following BACnet functional groups:

a. Files Functional Group.

b. Reinitialize Functional Group.

c. Device Communications Functional Group.

d. Please refer to section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

e. Standard BACnet object types supported shall include as a minimum-Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K thermistors or RTDs, 0-10 VDC, 4-20 mA, dry contact signals. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.

D. All program sequences shall be stored on board controller in EEPROM nonvolatile flash memory. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.11 SENSORS

A. General:

1. Provide sensors with specified output type for remote sensing of temperature, humidity pressure, and flow rate. Factory calibrate for the specific application.

2. Provide two or three wire sensors and transmitters. Whenever transmitters are indicated or are required as part of sensor provide transmitters with 0-10VDC or 4-20ma signal output.

B. Space Temperature:

1. Thermistor or RTD with minimum 32-150 deg F range, accuracy of plus or minus 0.4 deg F over full range, and maximum drift of 0.1 deg F/year. Removable covers with tamper proof fasteners.

C. Space Temperature - Tamper Resistant

1. Where tamper resistant sensors are indicated provide temperature sensor bonded to a stainless steel handy box cover plate.

2. Provide sensor with logo decal and insulated back.

D. Duct Air Temperature, Probe Type:

1. Thermistor or RTD with minimum 32 deg F to 150 deg F range, accuracy of plus or minus 0.4 deg F over full range, and maximum drift of 0.1 deg F/year.

2. Handy box enclosure, with probe length suitable for duct size.

E. Duct Air Temperature, Averaging Type:

1. Thermistor or RTD continuous sensing element inside copper tube with minimum 32 deg F150 deg F range, accuracy of plus or minus 0.75 deg F over full range, and maximum drift of 0.1F/year. Provide Sensor element length suitable for complete duct coverage.

F. Fluid Temperature:

1. Thermistor or RTD with minimum 30 deg F to 230 deg F range, accuracy of plus or minus 1.0 deg F over full range, and maximum drift of 0.5 deg F per year.

2. Provide threaded well to allow removal of element without draining system.

G. Outside Air Temperature:

1. Thermistor or RTD with minimum minus 58 deg F to 110 deg F range, Accuracy of plus or minus 1.0 deg F over full range, and maximum drift of 1 deg F per year. Provide with ventilated sun shield and weather proof box.

H. Fluid Pressure:

1. Gauge pressure transducer with range 150 percent of operating pressure and over pressure tolerance of 200 percent of range pressure, plus or minus 2 percent accuracy over full range, and maximum drift of 1 percent full range per year.

2. Watertight enclosure.

3. Provide with ball valve isolation.

I. Duct Static or Air Differential Pressure:

1. Differential pressure transducer with range 150 percent of operating pressure and over pressure tolerance of 200 percent of range pressure, plus or minus 2 percent accuracy

over full range, and maximum drift of 1 percent full range per year. Veris Px series or equal.

2. Provide static pressure tips for reference tubing at duct penetrations.

J. Current Sensor:

1. Current transformer and conditioning circuitry to convert AC line current to binary output, Veris Hawkeye or equal.

K. Indoor Air Quality Sensors:

1. Provide carbon dioxide sensors or VOC Volatile Organic Compound) sensor for sensing indoor air quality in rooms or air ducts.

2. Power Supply: 24VAC, 50-60Hz, max 6VA.

3. Range of Use: 0-2000ppm.

4. Tolerance: +/- 100ppm.

5. Voltage Output: 0-10Vdc.

6. Operating Temperature: 14-113 deg F.

7. Humidity: 0-95% RH.

L. Airflow Sensor Measurement Devices

1. Acceptable Manufacturers:

a. EBTRON, Inc.

b. Air Monitor.

c. No Substitutions.

2. Provide airflow sensor measurement devices as indicated in the sequence of operations. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.

3. Each measurement device shall consist of one or more sensor probe assemblies and a single microprocessor-based transmitter. Each sensor probe assembly will contain one or more independent sensor housings. Multiple sensor housings shall be equally weighted and averaged by the transmitter prior to output Vortex shedding flow meters are not acceptable.

4. All Sensor Probe Assemblies:

a. Each electronic sensor housing shall utilize two hermetically sealed thermistor probes to determine airflow rate and ambient temperature. Devices that do not have 2 thermistors in each sensor housing are not acceptable.

b. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor assembly shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).

c. Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.

d. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to a remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.

e. Each sensor assembly shall not require matching to the transmitter in the field.

f. A single manufacturer shall provide both the airflow measuring probe(s) and transmitter at a given measurement location.

5. Duct and Plenum Sensor Probe Assemblies:

a. Sensor housings shall be mounted in an extruded, 6063 aluminum tube probe assembly.

b. The number of sensor housings provided for each location shall be as follows:

1) Area (sq. ft.)	Sensors
<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=16	16

c. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:

1) Insertion mounted through the side or top of the duct.

2) Internally mounted inside the duct or plenum.

3) Standoff mounted inside the plenum.

d. The operating airflow range shall be 0 to 5,000 CFM unless otherwise indicated on the plans.

6. Fan Inlet Sensor Probe Assemblies (Allowed only at roof mounted relief fans upon written permission from the engineer).

   a. Sensor housings shall be mounted on 304 stainless steel blocks.

   b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.

   c. Mounting feet shall be constructed of 304 stainless steel.

   d. The operating airflow range shall be 0 to 10,000 CFM unless otherwise indicated on the plans.

7. Transmitters:

   a. The transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.

   b. The transmitter shall be capable of displaying the individual airflow and temperature readings of each sensor on the LCD display.

   c. The transmitter shall operate on 24 VAC. The transmitter shall be protected from weather and water.

   d. The transmitter shall be capable of communicating with the host controls using one of the following interface options:

      1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).

      2) BACnet-MS/TP.

      3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, The measuring device shall be UL listed as an entire assembly.

8. The manufacturer’s authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the mechanical engineer if any measurement locations do not meet the manufacturer’s placement requirements.

9. Install in accordance with manufacturer’s instructions at the locations indicated on the contract drawings. Duct and plenum devices shall not be adjusted without approval from the mechanical engineer.

2.12 CONTROL RELAYS

A. General: Provide relays rated for current and voltage requirements of controlled equipment.

B. Panel Mounted Relays:

1. Plug in type, with DIN rail mountable plug in sockets. IDEC RH series or equal.

2. UL listed.

C. Field Mounted Relays:

1. Solid state packaged relay including relay, LED indicator, provisions for mounting, transient protection and housing. Functional Devices RIB T series or equal.

2. Provide with a Hand-Off-Auto switch.

3. Provide internal separation between class 1 and class 2 wiring including separate wire ways or nipples.

4. UL listed.

2.13 CONTROL VALVES

A. Control valves shall be two-way or three-way type for two-position or modulating service as shown.

B. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

1. Water/Glycol Valves:

a. Two-way: 150% of total system (pump) head.

b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

C. Water/Glycol Valves.

1. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.

2. Sizing Criteria:

a. Two-position service: Line size.

b. Two-way and three-way modulating service: Pressure drop shall be sized for 3 psi maximum.

c. Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.

d. Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.

3. Water/Glycol valves shall fail normally open or closed, as scheduled on plans, or as follows:

a. Zone valves shall be normally open for heating applications.

b. Control valves shall be normally closed for hot water generators.

c. Heating coils in air handlers shall be normally open.

d. Chilled water control valves shall be normally closed.

e. Other applications-as scheduled or as required by sequences of operation.

2.14 DAMPER AND VALVE ACTUATORS

A. General:

1. Where exposed to outdoor air or air temperatures lower than 32 deg F provide completely weatherproof actuators with internal heaters to allow normal operation at minus 50 deg F.

2. Provide spring return to normal position type actuators except at and variable air volume terminal units where fail to last position actuators are acceptable.

3. Provide actuators of the following signal types:

a. Modulating Electronic Actuators. Actuator to convert electronic 1-10VDC or 4-20mA analog signal to a linear, positive positioning stroke. Provide modulating electronic actuators for modulating control except as indicated. Belimo or equal.

b. Tri-State Reversing or Floating Point Electric Actuators. Actuator to reverse or hold position depending on contact closure state. Tri-state reversing or Floating Point electric actuators may be used for terminal unit control. Belimo or equal.

c. Two Position Electric Actuator. Direct mounting actuator to open or close depending on contact closure state. Belimo or equal.

2.15 EMERGENCY BOILER SHUT OFF

A. Pushbutton with 40 mm diameter red mushroom head, NEMA 1 surface-mount box with clear hinged cover. Mount a red engraved nameplate with white letters that reads "Emergency Boiler Shut Down" on faceplate or wall above button. Provide NO or NC contact blocks as required to perform the specified sequence of operation. Contacts rated 600V @ 10A AC and 2.5A DC.

B. Kele ST120SL-N1-BS with PILCLHCOV1 Clear Hinged Cover or approved equal.

2.16 WIRING AND RACEWAYS

A. Provide wiring and raceway complying with the National Electrical Code, Division 26, State and Local Codes and Ordinances.

B. Raceways:

1. EMT, metal duct, IMC, surface metal raceways, or totally enclosed metal trough with flexible metal tubing unless otherwise noted.

2. Provide rigid steel conduit raceways when raceway is buried or embedded in concrete.

3. Provide 18 inches minimum to 36 inches maximum flexible metal conduit of galvanized steel construction for final connection to control devices. For connections to pipe mounted devices, and to devices in damp, wet, or exterior locations, or in mechanical rooms containing boilers, provide oil-resistant liquid-tight flexible metal conduit.

4. Provide EMT connectors with rain tight compression fittings and insulated throats.

5. Wire mould is generally not allowed except as approved on a case-by-case basis with the owner’s representative.

C. Wiring:

1. Provide wire with copper stranded conductors. Provide color or number coded jackets.

2. Low voltage wiring from control components to input/output modules: 20-gauge minimum foil-shielded cable rated 100 VDC at 80 deg C.

3. Provide plenum rated cable whenever wire is run without conduit.

4. Provide communications network wiring meeting the gauge, impedance, capacitance, resistance and shielding requirements specified by the manufacturer of the connected devices.

5. Identify wires and cables with permanent self-laminating machine print labeling system. Provide labels capable of receiving 8 characters of type written text, with minimum print on area of 1 inch by 1/2 inch, and protected by a clear sheath. Thomas & Betts E-Z Code or equal.

6. Support or bundle wire with self-locking, UL listed cable ties. Provide 40 lb rated cable ties incorporating a stainless-steel locking insert. Provide UL 94V-0 flammability rated, halar cable ties when installed without panel enclosure. Thomas & Betts Ty-Rap or equal.

7. Provide cable tie anchors designed for mechanical anchoring, allowing removal of cable tie without removal of anchor, capable of accepting at a minimum a number 8 screw. Adhesive cable tie anchors are allowed only on the interior surface of panel doors. Panduit TM series or equal.

2.17 PANELS

A. General: Investigate potential reuse of existing panel enclosures, otherwise locate new panels in same locations these panel were located.

1. UL listed, not over 24 inches wide by 42 inches high, constructed of 14 U.S.S gauge steel except that enclosures less than 20 inches in both dimensions may be 16 gauge. Provide multi-section or multiple individual panels as required. Hoffman or equal.

2. Equipped with subpanels.

3. Punched or stamped when needed to receive front mounted switches, gauges, indicating lights and alarms.

4. Secure to the front of every control panel that has more than one source of power the following warning label: The word "WARNING" shall be in 1-inch-high letters. Other letters shall be 1/4 inch high.

   a. WARNING Complete de-energization of this control panel requires that circuit breakers supplying all equipment controlled by this panel be opened.

5. Provide track mounted terminals with integral permanent labeling system. Integral screws for securing connected wires. Voltage and amperage ratings to match terminated wire ratings. Marathon or equal.

6. Provide nylon insulated crimp connectors with voltage and amperage rating matching connected wire ratings unless terminal strip is designed to connect to connected wire type without using a crimp connector. Thomas & Betts STA-KON connectors or equal.

7. Indicating lamps on panel shall be long life type, rated for a minimum life of 10,000 hours.

B. Interior Enclosures:

1. Piano hinged front with latch and lock.

2. Baked enamel finish.

3. Concealed enclosures may be standard electrical boxes.

2.18 VARIABLE FREQUENCY DRIVES (VFDs)

A. Description:

1. This specification covers a complete Variable Frequency Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor or better.

2. The drive manufacturer shall supply the drive, and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of fifteen years.

B. Acceptable Manufacturers:

1. ABB.

2. Square D.

3. Danfoss.

4. Yaskawa.

5. Substitutions: Under provisions of Division 01.

C. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE) Standard 519, IEEE Guide for Harmonic Content and Control.

2. Underwriters laboratories UL508C.

3. National Electrical Manufacturer's Association (NEMA) ICS 7.0, AC Adjustable Speed Drives.

D. Testing: All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104°F, at full rated load. All testing and manufacturing procedures shall be ISO 9001 certified.

E. Qualifications: VFDs and options shall be UL listed as a complete assembly. VFDs and options shall be cUL listed as a complete assembly. VFDs and options shall be CE labeled as a component. VFDs shall be listed for use at remote locations from devices.

F. Warranty: Warranty shall be 24 months from the date of shipment (with certified start-up).

G. Products: The Variable Frequency Drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output-switching device. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be no less than 0.98 at all speeds and loads. Provide VFDs that are compatible with motors provided under this project.

H. Harmonic Distortion Control:

1. The VFD shall limit harmonic distortion reflected onto the utility system to a voltage and current level as defined by IEEE 519 for general systems applications. This shall be accomplished by using drive components specifically designed to reduce harmonic

distortion. AC line reactors are required where their use will assist in reducing harmonic distortion.

2. Any harmonic calculations shall be done based on kVA capacity X/R ratio and the impedance of the utility transformer feeding the installation and the total system load. The calculations shall be made with the point of the common coupling being the utility feeder.

3. The system containing the VFD shall comply with the 5% level of total harmonic distortion on line voltage and the line current limits as defined in IEEE 519.

I. Specifications:

1. Input voltage 208-240, 380-480, 575-600 VAC +/- 10%, 3 phase, 48-63 Hz.

2. Undervoltage trip @ rated input -35%, Overvoltage trip @ rated input +30%.

3. Interrupt rating 65 kAIC, suitable for use on a circuit capable of delivering not more than 10,000 RMS symmetrical amps, 480 V maximum.

4. Output Frequency 0 to 150 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.

5. Environmental operating conditions: 0 to 4°C, 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.

6. Provide line side filter.

7. Enclosure shall be rated NEMA 1 or as specifically mentioned elsewhere.

8. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have it's own non-volatile memory. An optional keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

9. VFD shall be rated for use in remote located setups.

J. Input/Output Features:

1. Four (4) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

2. A custom PID preset for HVAC & fluid systems, allow a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over

current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, digital inputs, or over the communications bus.

3. Two (2) programmable analog inputs shall accept a current, voltage, or Ni 1000 sensor level input signal for speed reference, or for reference and actual (feedback) signals for PID controller.

4. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon customer reset (reclosure of interlock) drive is to resume normal operation. These inputs can also be used to activate the setpoints of individual control loops.

5. Two (2) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC.

7. The VFD shall Ramp or Coast to a stop, as selected by the user.

K. Operator Display: The following operating information displays shall be standard using an optional VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. All parameters viewed from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable).

1. Output frequency.

2. Motor speed (RPM, %, or engineering units).

3. Motor current.

4. Calculated motor torque.

5. Calculated motor power (kW).

6. DC bus voltage.

7. Output voltage.

8. Analog input values.

9. Analog output value.

10. Keypad reference values.

11. Digital input status.

12. Digital output status.

L. Safeties: The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop and announce the fault condition in complete words (alphanumeric codes are not acceptable):

1. Overcurrent trip 350% instantaneous (170% RMS) of the VFD's variable torque current rating.

2. Overvoltage trip 130% of the VFD's rated voltage.

3. Undervoltage trip 65% of the VFD's rated voltage.

4. Overtemperature +90° C, Heatsink Temperature.

5. Ground Fault either running or at start.

6. Adaptable Electronic Motor Overload (I 2 t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependent, are unacceptable. The electronic motor overload protection shall be UL Listed for this function.

M. Communications:

1. The VFD shall have an RS-485 port as standard. The standard protocol shall be selectable between Siemens Building Technologies, Inc. P1 (FLN) protocol, and Johnson Controls Inc. N2 Metasys protocol. There shall be an optional LON (LONMARK) interface and Modbus interface.

2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control (Set Point) adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, digital inputs and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.

3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control without being tied to a VFD function. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

N. Product Support: Factory trained application engineering and service personnel that are thoroughly familiar with the drive products offered shall be locally available at both the specifying and installation locations.

O. Required Features: The following features to be furnished and mounted by the drive manufacturer. All features shall be UL Listed by the drive manufacturer as a complete assembly.

1. Bypass Controller - Manual or automatic (selectable) transfer to line power via contactors. When in the "Drive" mode, the bypass contactor is open and the drive output contactor is closed. In the "Bypass" position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be Dry type 115V compatible and shall function in both the "Drive" and "Bypass" modes. The design shall include single-phase protection in both the VFD and bypass modes.

2. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, Drive or Bypass modes.

3. Automatic / manual bypass operation shall be selectable in the standard bypass design.

4. Door / cover interlocked disconnect switch will disconnect all input power from the drive, bypass and all internally mounted options. The disconnect handle shall be through the door, and be lockable in the "Off" position.

2.19 FIRESTOPPING

A. Capable of maintaining an effective barrier against flame, heat, and smoke. Metalines, Dow, 3M, or equal.

B. Provide installations classified in Underwriter's Laboratories (UL) Building Materials Directory or listed in the Warnock Hersey International Directory.

C. Paintable where exposed to view.

D. Waterproof in plumbing chases.

E. Provide the product of more than one manufacturer if required to provide listed installations throughout.

PART 3 EXECUTION

3.01 GENERAL

A. Modify existing control system devices as indicated. Extend and modify the existing wiring and control system power source to accommodate indicated direct digital control system devices.

B. Before beginning installation of new system components, test the existing system devices that are being reused in modified control systems for proper operation and report any devices in need of replacement or repair to the Project Manager. At the option of the Project Manager, he will issue a contract amendment to replace or repair the defective devices or he will have Owner maintenance personnel replace or repair the defective devices. The Contractor shall be responsible for providing new devices to replace existing devices that are not brought to the Project Manager’s attention before beginning installation of new system components.

C. Work must comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards. Perform work by persons qualified to produce

workmanship of specified quality. If required by the State of Alaska workers shall be licensed. If requested provide copy of license.

D. Do not install control devices in locations where they are subject to damage or malfunction due to normally encountered ambient temperatures.

E. Mount damper operators and other control devices secured to insulated ductwork on brackets such that the device is external of the insulation.

F. Schematics and diagrams, when indicated on the Drawings, show approximate functional relationships and sequences only. All required devices are not shown. Contractor is responsible for providing all components required for a complete functioning system selected to meet the specific functional requirements of each application.

G. Hard wire control devices. Do not use power line carriers.

H. Ensure that the direct digital controller network, and power wiring will support both a 15 percent increase in network length, and a 10 percent increase in controllers similar to those installed without having to add additional network repeaters, increase power wire size or circuit breaker capacity.

I. Unless indicated otherwise, connect the primary sensing input and the associated output for each control loop to the same controller. A secondary or resetting input may be attached to any controller and communicated over the network.

J. After the final inspection and subsequent punch list inspections provide wiring schematic and Control Drawings with written sequence of operations, 11 inches by 17 inches in size, produced from the as-built Control Drawings. Provide one copy in each Operation and Maintenance Manual, and one copy, at its applicable control panel. Provide one set of system backup on USB drive to restart and reload all programmable devices used in the control system.

K. Tune control loops to respond quickly to control fluctuations without hunting.

L. Label control devices mounted in the field and within control cabinets with 1/4 inch high white embossed letters and black tape background. Dymo or equal. Tags to match tags used on Control Drawings.

3.02 DEMOLITION

A. Remove existing valves, dampers, operators, sensors, and controllers that are replaced by new devices or that are not reused. Present all removed equipment to owner for first right of refusal before disposing of equipment. Review copy of existing system “As-Built” control schematics for existing device location and extent of required demolition.

B. Patch holes in existing ductwork at removed sensors that are not reused with sheet metal patches of equal gauge or heavier material sheet metal that are seal airtight with adhesive and then screwed or pop riveted to the ductwork.

C. Existing conduit and wiring may be reused when available and when wiring is rated for application. Remove existing unused conductors.

D. Demolish unused pneumatic tubing back to main air connection. Plug tubing with brass fittings.

E. Repairs: Any portion of the facility damaged, cut back or made inoperable shall be repaired with similar materials as the existing structure and/or damaged item as instructed by the Project Manager.

3.03 SHUT DOWN OF EXISTING SYSTEMS

A. Refrigeration, Heating and Ventilation are critical to the function of the facility. Schedule any required shutdowns with Project Manager. Provide a minimum of 5 days written notification to the Project Manager.

B. This building depends on operation of the ventilation systems for space heating and cooling. During system shutdowns the contractor is responsible for maintaining all spaces within the building at a minimum temperature of 68 deg F. and maximum of 77 deg F.

3.04 WIRING AND RACEWAYS

A. Permanently label electrical or electronic wiring at each end indicating location and the device at opposite end. At the direct digital controller end use either the I/O address, if it describes the connected device, or the unique control device tag used on the control schematics. At the device end indicate both the terminal number and the controller connected at the other end. For color coded multi-conductor cable, label cable sheath not individual conductors.

B. At field devices where conductors are not wired to terminal strips wire using a unique color for each conductor connected to that device.

C. Install wiring in a neat and orderly manner generally running along building lines.

D. Support low voltage wiring run without conduit at a maximum of 4 feet between anchors.

E. Seal conduit penetrations at floor and wall penetrations with firestopping installed as indicated. Note that this applies to all floor and wall penetrations, not just fire barrier penetrations. At all mechanical rooms or other rooms containing floor drains, except those with slab on grade floors, make penetration watertight and extend sleeve 3 inches above the floor.

F. Wire all electrical controls and switches furnished under this Section of the Specifications.

G. Make wire connections using factory fabricated jack assemblies, terminal strips, or solder connections. Use crimp connectors on stranded wire unless connecting to terminal strips approved for direct stranded wire connection. Insulate solder connections with heat shrink tubing. Field connections in control power wiring circuits may be made using wire nuts.

H. Avoid splices in signal wire, where unavoidable connect with solder connections and label on each side of splice. Use identical wire type and color on each side of splice.

I. Conceal wiring in finished areas. Unless otherwise noted, install wiring inside conduit or fully enclosed metallic raceway.

J. Low voltage wiring installed in concealed accessible locations may be run without conduit. Sleeve wiring at wall penetrations.

K. Metal raceways crossing expansion joints make provision for 3 way movement. For conduits 1 & 1/2 inch and larger use O-Z type DX fittings, or equal.

L. At raceway penetrations of the vapor barrier provide a double splice patch (one on each side of vapor barrier) by cutting a square piece of vapor barrier 12 inches larger on all sides than the pipe. Cut a round hole in the center of the square splice patch, smaller than the pipe, to form a stretched fit. Force the pipe through the splice patch and tape all sides to the vapor barrier and seal the vapor barrier to the pipe at the penetration with an adhesive compatible with the vapor barrier material.

M. Securely seal at both ends, raceways running from a warm area to a cold area. Ductseal or equal.

N. Install all wiring in accordance with National Electrical Code and State and Local Codes and Ordinances.

3.05 PANELS

A. Provide UL listed panel assemblies when required by local authorities.

3.06 VARIABLE FREQUENCY DRIVES (VFDs)

A. Install in accordance with manufacturers installation instructions.

B. Installation shall be the responsibility of the Division 26 electrical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

C. Power wiring shall be the responsibility of the Division 26 electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

D. Start-up: Provide certified factory start-up shall be provided for each drive by a factory authorized service center. Start-up shall include verification of input/output wiring, voltage, current and control settings. A certified start-up form shall be filled out for each drive with a copy provided to the owner, included in the operations and maintenance manual, and a copy kept on file at the manufacturer.

3.07 SENSORS AND SWITCHES

A. Mount room sensors and fan control switches in offices 48 inches above finished floor, with any operable portion no higher than 48 inches, unless otherwise indicated. Where adjacent to light switches mount at same height as switches to provide a clean horizontally aligned installation

unless doing so requires the operable portion to be above 48 inches. For sensors with tamper proof guards, sensors may be mounted between 48 inches and 60 inches above finished floors.

B. Provide tamper proof protective guards for all components installed in public spaces. Concealed sensors can be used in lieu of protective guards if approved by Engineer.

C. Liquid or air flow across pumps, and fans, etc. shall be sensed using current sensor unless indicated otherwise.

D. Differential pressure transducers shall be used to sense differential pressure unless indicated otherwise.

E. Connect low temperature limit switches directly to the controlled equipment's motor starter control coil or, for equipment with no motor starter, to contacts of a relay in the equipment's power circuit.

F. Fill immersion fluid temperature sensor wells with heat conducting compound. At 1-1/2 inches and smaller piping install wells in pipe tees one size larger than line size.

G. Provide sensors and thermostats installed on exterior surfaces with insulated bases such that actual room temperature not wall surface temperature is sensed.

H. Provide ventilated, non-breakable shields and mounting brackets for sensors which are indicated to have protective covers.

I. Provide averaging sensors in air handling unit casings or in areas where stratification is likely to occur. Provide averaging element of sufficient length to accurately indicate the average duct temperature.

J. Protect averaging or capillary tubes where they penetrate duct with rubber grommet and seal with clear silicon. Support averaging or capillary tubes with copper capillary clips which maintain a minimum tubing bend radius of 1 inch.

3.08 CONTROL POWER SUPPLY

A. Provide uninterruptible power supply (UPS) on power supply to all control panels and control transformers.

B. Provide electric power to control devices from control system power circuit or from device or equipment being controlled.

C. Carry a dedicated ground wire to controllers from the associated breaker panel. Do not use the conduit system for grounding purposes.

3.09 TESTING AND ADJUSTING

A. Upon completion of the installation, the contractor shall initiate operation of the control system and perform all necessary testing and diagnostics to ensure proper operation. A formal commissioning procedure shall be utilized to insure complete system integrity and conformance to these specifications. This procedure shall consist of two separate steps incorporating point

verification and program verification. Commissioning forms shall address all field devices, field controllers, software statements, and software points. Submit for approval a written testing procedure indicating how each of these steps will be accomplished at least two weeks prior to the start of the commissioning process.

B. Verify correct installation and wiring of all points.

C. Prior to commissioning the system, submit for approval Point Verification Commissioning Forms listing all points for the system.

D. Confirm that all devices are installed correctly. Verify that terminations are tight and of correct polarity. Document and signoff the results on Point Verification form.

E. Coordinate the final adjustments and "fine tuning" of control functions and devices so that the building, the mechanical systems, and the control systems operate and respond as an integrated, comfortable and energy efficient component of this facility.

F. Upon completion of start up test existing smoke detectors to ensure fan shutdown. Note that test of circuitry is sufficient.

G. Verify that all points are wired to the correct termination block at the control panel by verifying continuity between the device and the panel termination. Document and signoff results on Point Verification form. Verify that each sequence performs as specified in contract documents. Tune each loop as required for proper operation.

H. Document and signoff the results on Program Verification form.

I. Command all digital output points on and off and confirm proper operation of the associated output device. Command all analog output points to various levels within their range and confirm proper operation of the associated output device. Activate all digital input sensors and confirm proper point status at the panel. Measure conditions at all analog input sensors with an independent reference device, calibrate as required, and confirm proper point status at the panel. Document and signoff the results on Point Verification form.

J. Deficiencies revealed by failed test(s) shall be repaired and corrected and the test(s) repeated until successful.

K. Provide Substantial inspection data to consist of the following as a minimum:

1. Provide signed off Point Verification commissioning forms to mechanical engineer and owner prior to owner acceptance walkthrough.

2. Provide signed off Point Verification forms indicated the correct execution of all sequence of operations for each piece of equipment. List test procedure and results.

3. Point logs indicated point values with time and date stamp.

3.10 SPECIAL TOOLS AND SPARE PARTS

A. Provide three sets of special tools required to adjust control devices. This includes allen wrenches and other special tools. This does not include common tools such as pliers, adjustable wrenches, flat blade or Phillips screwdrivers. This set shall be provided during Owner instruction period and proper use shall be demonstrated to Owner personnel during said period.

3.11 DATABASE ARCHIVAL AND UPGRADE

A. Provide a complete database backup USB drive for the building management system and each direct digital controller to the Owner at final inspection. If software modifications are required during the warranty period update USB drive.

3.12 ORIENTATION AND TRAINING

A. Provide 40 hours of on-site orientation and training to Owner personnel designated by the Project Manager. Orientation and training sessions shall be conducted by a factory trained manufacturers representative familiar with the systems software, hardware, and accessories. Limit training time per day to 6 hours. Complete training and orientation according to the following schedule:

1. 24 hours (3 days) of instruction after acceptable performance of the system hardware and software has been established and prior to final inspection.

2. 16 hours (2 days) of instruction six months after final inspection.

B. Submit proposed training dates and instruction session course outlines for acceptance by Project Manager.

C. Provide instructions on all the operations listed in the initial course outline during the first training session. On subsequent sessions communicate in advance with facility supervisor to determine which operations require additional instruction.

D. Initial course outline:

1. Determine the control strategies that have been defined for a specific piece of equipment.

2. Utilize X-Y graphing and histories as an aid for control loop tuning.

3. Enable or disable control strategies.

4. Assign sensors and/or actuators to a control strategy.

5. Simulate control strategies with substituted inputs or outputs.

6. Define appropriate control loop algorithms and choose optimum loop parameters for loop control.

7. Add/delete control loops to the system.

8. Add/delete points to the system.

9. Label parameters and variables with names or acronyms of a minimum of eight letters.

10. Select points to be alarmable and define the alarm state(s).

11. Download programming to the system after all direct digital controllers and building management station program memory has been lost.

12. Process stored historical data and display and printout data in tabular and graphical formats.

13. Diagnose system malfunctions.

14. Change system operating sequences.

3.13 SUBSTANTIAL INSPECTION REQUIREMENTS

A. Substantial inspection data must be submitted for review, reviewed by the Project Manager, corrected in accordance with review comments, and accepted by the Project Manager before a request for final or substantial completion inspection will be considered by the Project Manager.

B. Prior to the substantial inspection, review and test entire installation for conformance with contract documents. Test shall include thorough field check of sequence of operations for each system and piece of equipment including simulation of all possible modes of operation. With the call for inspection, verify in writing that this system review and test has been performed and anything not conforming to contract documents shall be so noted.

C. During the Substantial inspection Contractor personnel shall provide on-site assistance to inspection personnel required for a complete and thorough inspection.

D. During the Substantial inspection Contractor personnel shall demonstrate that the control system performs in accordance with the contract documents. Provide material and personnel required to perform the demonstration.

END OF SECTION

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SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Boiler Water.

B. Heating Water Pumps.

C. Glycol Water.

D. Glycol Water Pumps.

E. Domestic Hot Water Heaters.

F. Air Handling Unit.

G. DX Condensing Unit.

H. Relief Fans.

I. Building Pressurization.

J. Existing Equipment.

1.02 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 09 23 - Direct Digital Control System for HVAC.

C. Section 23 21 23 - Hydronic Pumps.

D. Section 23 52 16 - Condensing Boilers.

E. Section 23 63 00 - Refrigerant Condensers.

F. Section 23 73 00 - Indoor Central Air-Handling Units.

G. Section 23 74 00 - Packaged Outdoor HVAC Equipment.

1.03 SYSTEM DESCRIPTION

A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

1.04 SUBMITTALS

A. Submit under provisions of Division 01.

B. Submit diagrams indicating mechanical system controlled and control system components. Label with settings, adjustable range of control and limits. Include written description of control sequence.

C. Include flow diagrams for each control system, graphically depicting control logic.

D. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.05 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Division 01.

B. Accurately record actual setpoints and settings of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL

A. See contract drawings for all sequences, monitoring, and alarms.

END OF SECTION

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC

B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 05 19 - Meters and Gages for HVAC Piping.

D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

E. Section 23 05 48 - Vibration and Seismic controls for HVAC Piping, Ductwork and Equipment.

F. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

1.03 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include data on pipe materials, pipe fittings, valves and accessories.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, ABOVE GRADE

A. Piping: Steel Pipe ASTM A53, Schedule 40 black. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, forged steel welding type.

B. Joints:

1. Low pressure, 2” and under: Screwed or Viega MegaPressG Cold Press Mechanical Joint. Press fittings are acceptable to last tee for connection to the appliance. Utilize threaded piping at the last tee.

2. Medium pressure or larger than 2”: ANSI/AWS D1.1, welded.

2.02 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping: 1/16 inch thick preformed neoprene bonded to fiber.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.03 ACCEPTABLE MANUFACTURERS – GAS COCKS AND BALL VALVES

A. Apollo.

B. Hammond.

C. Milwaukee.

D. Nibco.

E. Substitutions: Under provisions of Division 01

2.04 GAS COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug. non-lubricated, Teflon packing, threaded ends.

B. Over 2 Inches: Cast iron body and plug, non- lubricated, Teflon packing, flanged ends.

2.05 BALL VALVES

A. Up to 2 Inches: Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle, solder, threaded or press-fit ends.

B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged, solder, threaded or press-fit ends.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Verify that excavations are to required grade, dry, and not over excavated.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Install valves with stems upright or horizontal, not inverted.

K. Provide properly sized handles for valve operation. Handles shall not be cut or bent to make fit where installed.

3.03 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.04 TESTING

A. Test all piping in accordance with the requirements in the latest edition of the IFGC and UPC as adopted by the MOA. The test pressure used shall be no less than 10 times the proposed maximum working pressure, but not less than 10 psig for low pressure gas systems (7 inch WC) or 60 psig for medium pressures gas systems (2 psig or 5 psig). All welded pipe shall be tested with not less than 60 psig test pressures.

END OF SECTION

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SECTION 23 21 13 - HYDRONIC PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe and Pipe Fittings.

B. Valves.

C. Heating Water and Glycol Piping.

D. Chilled Water and Glycol Piping.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 05 19 - Meters and Gages for HVAC Piping.

D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

E. Section 23 05 48 - Vibration and Seismic controls for HVAC.

F. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

G. Section 23 07 00 - HVAC Insulation.

H. Section 23 09 23 - Direct Digital Control System for HVAC.

I. Section 23 21 16 - Hydronic Piping Specialties.

J. Section 23 21 23 - Hydronic Pumps.

K. Section 23 52 16 - Condensing Boilers.

L. Section 23 57 00 - Heat Exchangers for HVAC.

M. Section 23 73 00 - Indoor Central Air-Handling Units.

1.03 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

1.04 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.05 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

1.06 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves, and components.

B. Hydronic System Cleaning and Test reports: Submit to owner for approval. Include all cleaning and testing reports in final O&M manuals.

1.07 WARRANTY

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40, for sizes 4 inch and over, black.

1. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, steel welding type fittings.

2. Joints: Screwed, or ANSI/AWS D1.1, welded.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ANSI/ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings or ANSI/ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

2. Joints: ASTM B32, solder, Grade 95TA or ANSI/AWS A5.8, BCuP silver braze; Flux: ASTM B813.

3. Press Fittings: The press fittings connections shall be compatible with seamless K, L or M copper tube made to ASTM B 88. Fittings shall have a maximum non-shock working pressure of 200 PSI between the temperatures of -20°F and +250°F. Elastomeric seals shall be made of EPDM material. Acceptable manufacturers: Viega ProPress or Nibco Press System.

C. Grooved piping systems are not allowed.

2.02 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.

2. Joints: Screwed, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ANSI/ASME B16.18 cast bronze, or ANSI/ASME B16.29 solder wrought copper.

2. Joints: ASTM B32, solder, Grade 95TA or ANSI/AWS A5.8, BCuP silver braze; Flux: ASTM B813.

C. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inch and larger, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.

2. Joints: ASTM D2855, solvent weld.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; C-shape elastomer composition sealing gasket for operating temperature range from -30º F to 230º F; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

2.04 ACCEPTABLE MANUFACTURERS - ALL VALVE TYPES

A. Apollo.

B. Crane.

C. FNW.

D. Hammond.

E. Milwaukee.

F. NIBCO.

G. Red-White Valve Corp.

H. Substitutions: Under provisions of Division 01.

2.05 BALL VALVES

A. Up to 2 Inches: 600 PSI CWP Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle, solder or threaded ends. Seat material to be compatible with fluid handled.

B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged. Seat material to be compatible with liquid handled.

2.06 PLUG COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends, with one wrench operator for every ten plug cocks.

B. Over 2 Inches: 285 CWP Cast iron body and plug, pressure lubricated, Teflon packing, flanged ends, with wrench operator with set screw.

2.07 GATE VALVES

A. Gate valves will not be permitted. Use ball valves for isolation.

2.08 BUTTERFLY VALVES

A. Butterfly valves will not be permitted. Use ball valves for isolation.

2.09 SWING CHECK VALVES

A. Up to 2 Inches: Bronze 45º swing disc, solder ends.

B. Over 2 Inches: Iron body, bronze trim, 45º swing disc, renewable disc and seat, flanged ends.

2.10 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.

2.11 VFD PUMP CHECK VALVES

A. Center guided silent check for use with VFD Pump. ASTM A126 CL. B Cast Iron body; ASTM T304 stainless seat, plug, spring, bushing and screw. 190 PSI at 200º. Valve complies with MSS-SP-125. ANSI B16.5 steel flange connections.

2.12 RELIEF VALVES

A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.13 HYDRONIC SYSTEM CLEANER

A. Acceptable Products:

1. CH2O Boil Out Liquid

2. Oatey Hercules Boiler and Heating System Cleaner.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space and other work.

C. Group piping whenever practical at common elevations.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

E. Provide clearance for installation of insulation, and access to valves and fittings.

F. Provide access where valves and fittings are not exposed.

G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

H. Install valves with stems upright or horizontal, not inverted.

I. Provide properly sized handles for valve operation. Handles shall not be cut or bent to make fit where installed.

J. Press Fittings shall be installed in accordance with the manufacturer’s installation instructions.

K. Support all piping in accordance with International Mechanical Code and Manufacturer installation instructions. Where there is a conflict between requirements of the Mechanical Code and Manufacturer installation instructions, the more restrictive requirement shall apply.

3.03 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Provide spring loaded check valves on discharge of pumps.

E. Provide ¾ inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.

3.04 CLEANING OF THE HYDRONIC SYSTEM

A. General Requirements

1. Provide complete flushing, cleaning, and chemical treatment of all hydronic systems, including:

a. Glycol hydronic system

b. Water hydronic system

2. Cleaning requirements apply to the entire system, including all existing piping, new piping, equipment, coils, heat exchangers, pumps, valves, and appurtenances.

3. Cleaning shall be performed as a coordinated, system-wide operation and shall not be limited to newly installed piping.

4. Submit a detailed Hydronic System Cleaning Plan for review prior to execution.

B. Pre-Cleaning and System Preparation

1. Drain existing system fluid prior to piping modifications.

2. Glycol systems shall have fluid captured and disposed of properly.

3. Provide backflow prevention during flushing and filling operations.

4. Isolate welded piping using temporary gasketed mesh strainers.

C. Temporary Filtration and Strainers

1. Install temporary gasketed mesh strainers at pump suctions, equipment connections, and steel-to-copper transitions.

2. Maintain temporary strainers throughout flushing and cleaning.

D. Initial Flushing Operations

1. Perform multiple fill-and-drain cycles using potable water.

2. Operate pumps and vent air at all high points.

3. Coordinate controls to ensure full flow through all zones.

E. Chemical Cleaning

1. Introduce an approved hydronic system cleaner.
2. Circulate for a minimum of four (4) hours or as recommended.
3. Operate system near design temperature where permitted.

F. Final Flushing, Screen Removal, and Documentation

1. Drain system and flush all low points.
2. Remove temporary strainers and clean permanent baskets.
3. Provide photo documentation of strainers and clean discharge water.

G. Final Fill and Owner/EOR Approval

1. Do not proceed with final fill until Owner approval is received.
2. Fill glycol and water systems per contract documents.
3. Add corrosion inhibitor as required.

H. Verification and Certification

1. Submit written certification of completion.
2. Include chemical usage and confirmation of strainer removal.

I. TAB Coordination

1. Cleaning shall be complete prior to TAB.
2. Correct debris-related deficiencies at no additional cost.

3.05 TESTING

A. Steel Piping and Copper Tubing: Test piping and tubing hydrostatically at 100 psig or 150 percent of working pressure, whichever is greater, for a period of 4 hours. Observe piping during this period and repair all leaks. Provide signed test statements and photographic evidence of all segments of tested piping.

END OF SECTION

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SECTION 23 21 16 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Expansion Tanks.

B. Air Vents.

C. Air Separators.

D. Hydraulic Separators.

E. Magnetic Strainers.

F. Pump Suction Fittings.

G. Combination Fittings.

H. Balance Valves.

I. Flow Control Valves.

J. Relief Valves.

K. Glycol Specialties.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

C. Section 23 05 48 - Vibration and Seismic controls for HVAC.

D. Section 23 09 23 - Direct Digital Control System for HVAC.

E. Section 23 21 23 - Hydronic Pumps.

F. Section 23 52 16 - Condensing Boilers.

G. Section 23 57 00 - Heat Exchangers for HVAC.

1.03 REFERENCES

A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.04 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section 8D for manufacture of tanks.

1.05 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.06 SUBMITTALS

A. Submit product data under provisions of Division 01 and Section 23 05 00.

B. Submit glycol solution test results with glycol percentage and PH after system fill procedures are completed.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - DIAPHRAGM-TYPE COMPRESSION TANKS

A. Amtrol.

B. Taco.

C. Bell & Gossett.

D. Substitutions: Under provisions of Division 01.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gauge and air-charging fitting, tank drain; pre-charge to 12 psig.

C. Size: As scheduled on the contract drawings.

2.03 ACCEPTABLE MANUFACTURERS - AIR VENTS

A. Hoffman.

B. Taco.

C. Spirotherm.

D. Substitutions: Under provisions of Division 01.

2.04 AIR VENTS

A. Manual Type: Disk type vent with built-in check valve for manual or automatic operation, discs replaceable without draining system, 1/8 inch shank, rated at 50 psi; Hoffman No. 508 or equal.

B. Float Type: Maintenance free solid brass construction, continuous air venting, 150 psig standard working pressure, 240° F maximum temperature, 1⁄2 inch male tread at vent point for pressure testing or remote venting, 1/2 or ¾ inch female threaded connections. Provide with mini ball valve for isolation. Taco 409 , Spirotherm Spirotop VTP or approved equal.

C. High Capacity Automatic Air Vent: Cast iron body, stainless steel and brass trim, EPDM diaphragm, rated for 250°F, 2 PSIG through 150 PSIG, ¾ inch system connection, 3/8 inch NPT connection to atmosphere with drain piping. Provide with isolation valve and strainer upstream of vent. Armstrong AAE-750 or equal.

2.05 ACCEPTABLE MANUFACTURERS - AIR SEPARATORS

A. Spirotherm.

B. Caleffi.

C. Amtrol.

D. Taco.

E. Substitutions: Under provisions of Division 01.

2.06 AIR SEPARATORS

A. Coalescing type combination air eliminator and dirt separator fabricated of steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 01 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles. Unit shall include internal elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill. Include removable lower head for internal inspection.

B. Air Elimination Valve: Bronze, float operated, for 125 psig operating pressure.

2.07 ACCEPTABLE MANUFACTURERS - HYDRAULIC SEPARATORS

A. Spirotherm.

B. Caleffi.

C. Substitutions: Under provisions of Division 01.

2.08 HYDRAULIC SEPARATORS

A. Coalescing type combination hydraulic, air, dirt, and magnetic separator fabricated of steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 01 for unfired pressure vessels. Unit shall include internal elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must consist of a stainless steel screen/coalescing medium. An external and removable neodymium rare-earth magnet shall be provided, with 100% ferrous impurities separation efficiency. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill. Include removable lower head for internal inspection.

2.09 ACCEPTABLE MANUFACTURERS – MAGNETIC STRAINERS

A. Bell & Gossett.

B. Jomar.

C. Metraflex.

D. Taco.

E. Substitutions: Under provisions of Division 01.

2.10 MAGNETIC STRAINERS

A. General: Strainers shall be magnetic Y-pattern type, low pressure drop with integral neodymium magnet(s) (minimum 8,000 gauss) housed in a stainless steel drywell for removal of ferrous debris. Units shall have cast iron bodies, Type 304 stainless steel removable screens, 125-lb flanged connections, and pressure differential ports.

B. Size 2 inch and Under: Screwed brass or iron body with 1/32 inch stainless steel perforated screen.

C. Size 2 inch to 3 inch: Flanged iron body with .045 inch stainless steel perforated screen.

D. Size 4 inch and Larger: Flanged iron body with 1/8 inch stainless steel perforated screen.

2.11 ACCEPTABLE MANUFACTURERS - PUMP SUCTION AND DISCHARGE FITTINGS

A. Bell & Gossett.

B. Jomar.

C. Metraflex.

D. Taco.

E. Substitutions: Under provisions of Division 01.

2.12 PUMP SUCTION FITTINGS

A. Suction Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-½ inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

B. Suction Fitting Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.13 PUMP FITTINGS WITH FLOW STRAIGHTENING

A. Flexible hose connectors on suction and discharge side of pump with section of corrugated metal house, and braid, with carbon steel plate flange end connections. Corrugated Hose shall be type 304 Stainless Steel. Braid shall be type 304 Stainless Steel. End fittings shall be carbon steel plate flange with 150 lb. drilling.

B. Incorporate internal flow straightening vanes on fitting on discharge side of pump to reduce turbulence prior to the balancing valve. Vanes to be capable of reducing discharge turbulence equal to 5-10 pipe diameters of straight pipe, while allowing full rated movement of the connector.

C. Suction and discharge fitting shall be configured with short radius elbow.

D. Metraflex CRV Flex and Vane Flex or approved equal.

2.14 ACCEPTABLE MANUFACTURERS - COMBINATION PUMP DISCHARGE VALVES

A. Bell & Gossett.

B. Jomar.

C. Taco.

D. Substitutions: Under provisions of Division 01.

2.15 COMBINATION PUMP DISCHARGE VALVES

A. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.16 ACCEPTABLE MANUFACTURERS - FLOW CONTROL VALVES

A. Griswold.

B. Hydronic Components, Inc., HCI

C. Substitutions: Under provisions of Division 01.

2.17 FLOW CONTROL VALVES

A. Construction, Valves 2” and Smaller: ASTM B584 Brass body, rated at 300 psig @ 250 ºF with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

B. Construction, Valves larger than 2”: Class 150 Flange End Valves shall consist of steel pipe with flange ends, and stainless steel flow control cartridge assembly; 230 psig @ 250 ºF; flange ends compatible with ANSI B 16.5-2017 150 lb. Steel flanges shall be permanently marked to show direction of flow.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 14 times minimum pressure required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 2 psi differential pressure to actuate the mechanism.

D. Control Mechanism: Stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.

E. Accessories:

1. In-line strainer on inlet and ball valve on outlet.

2. Pressure/temperature test valves.

3. Provide Identification tags indelibly marked with flow rate, model number, zone identification. Tags shall be 3" x 3" aluminum.

2.18 ACCEPTABLE MANUFACTURERS - BALANCE VALVES

A. Bell & Gossett.

B. Jomar.

C. Taco.

D. Substitutions: Under provisions of Division 01.

2.19 BALANCE VALVES

A. Valves 2” and Smaller: Bronze or brass body rated for 300 PSIG working pressure, temperature range shall be from -4°F to 250°F, type 304 Stainless Steel ball valve. Valve body shall include two pressure/temperature ports, a drain valve port and a calibrated nameplate with a memory stop. NPT or sweat end connections.

B. Valves Larger then 2”: Cast Iron body rated for 175 PSIG working pressure, temperature range shall be from -4°F to 250°F, brass ball valve. Valve body shall include two pressure/temperature ports, a drain valve port and a calibrated nameplate with a memory stop. Flanged end connections.

2.20 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

A. Watts.

B. Taco.

C. Bell & Gossett.

D. Substitutions: Under provisions of Division 01.

2.21 RELIEF VALVES

A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.22 GLYCOL SYSTEM

A. HDPE storage/mixing tank with cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out; integral pressure switch; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm; manual diverter valve for purging air and agitating contents of storage tank; 10 to 25 psi pressure adjustable regulating valve complete with pressure gauge; integral replaceable strainer; built-in check valve; union connection; low level pump cut-out. Pressure pump shall be capable of running dry without damage. Provide unit with RIA10-1, Low pressure alarm panel with Remote monitoring dry contracts. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

B. Glycol Solution: Triafrost PGX, Inhibited propylene glycol and water solution mixed 50-50 suitable for operating temperatures of -29º F. The glycol shall be delivered to site in sealed containers, provide with color dye selected by owner.

2.23 HEATING SYSTEM FILTER

A. Construction: Continuous electric welded tube body, code semi-elliptical heads, sealed filter chamber, filter, filter support device and inlet/outlet/drain and fill port, rated for 200 psi at 200º F. Body shall be A513 tube minimum .134” thick. Heads shall be 2:1 semi-elliptical ASME code

type SA-414G and a minimum of .104" thick. Dome bottom, side inlet and outlet flange fittings, three welded carbon steel legs.

B. Filter: Filter feeder shall be supplied with 20-micron high temperature re-usable pleated filter, stainless steel holder and stainless steel removal handle so that personnel shall not come in contact with vessel contents. Provide two spare filters.

C. Accessories:

1. Sight flow indicator to indicated flow, rated for 125 psi at 200º F.

PART 3 EXECUTION

3.01 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

B. Support tanks inside building from building structure in accordance with manufacturer's instructions.

C. Where large air quantities can accumulate, provide enlarged air collection standpipes.

D. Provide manual air vents at system high points and as indicated.

E. For automatic air vents, provide vent tubing to nearest drain or back to glycol tank if in mechanical room. Where a drain is not available run discharge to a 12"x12"x6" high galvanized, water tight pan located in an accessible location.

F. Provide air separator on suction side of system circulation pump and connect to expansion tank.

G. Provide valved drain and hose connection on strainer blow down connection.

H. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

I. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

J. Support pump fittings with floor mounted pipe and flange supports.

K. Provide shutoff valves on inlet and outlet to terminal heating units such as radiation, unit heaters, and fan coil unit.

L. Provide balancing valves on outlet from terminal heating units.

M. Provide relief valves on pressure tanks, low pressure side of reducing valves, and heat exchangers.

N. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

O. Pipe relief valve outlet to nearest floor drain for water systems.

P. Pipe relief valve outlet to glycol tank for glycol systems.

Q. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.02 GLYCOL APPLICATION

A. Clean and flush piping system before adding glycol solution. All of the existing glycol in the system shall be thoroughly flushed from the hydronic system and disposed of. See Specification Section 23 21 13 for hydronic system cleaning procedures.

B. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill at 24 psig. Pressure system cold at 5 psig, adjust when hot to 24 psig.

C. Perform tests determining strength of glycol and water solution and submit written test results.

3.03 AIR VENT APPLICATION SCHEDULE

Location	Type
Terminal heating units, mains below	Manual
Terminal heating units, mains above	None
Heating mains, at high points in system	Automatic
Combination air separator/strainers	High capacity

Note: For terminal heating units, mains above unit, install branch piping connections at bottom of mains or 45° from bottom to allow air migration to mains.

END OF SECTION

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SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 GENERAL

1.01 WORK INCLUDED

A. In-line Circulators.

B. Vertical In-line Pumps.

C. Base Mounted Pumps.

D. Side-stream Filters.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 05 19 - Meters and Gages for HVAC Piping.

D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

E. Section 23 05 48 - Vibration and Seismic controls for HVAC.

F. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

G. Section 23 09 23 - Direct Digital Control System for HVAC.

H. Section 23 21 13 - Hydronic Piping.

I. Section 23 21 16 - Hydronic Piping Specialties.

1.03 REFERENCES

A. ANSI/UL 778 - Motor Operated Water Pumps.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years' experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright and alignment certified.

1.05 SUBMITTALS

A. Submit product data under provisions of Division 01.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

1.08 EXTRA PARTS

A. Provide one extra set of mechanical seals for pumps.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Grundfos.

B. Bell & Gossett.

C. Taco.

D. Wilo.

E. Substitutions: Under provisions of Division 01.

2.02 GENERAL CONSTRUCTION REQUIREMENTS

A. Balance: Rotating parts, statically and dynamically.

B. Construction: To permit servicing without breaking piping or motor connections.

C. Pump Motors: Operate at 1750 rpm unless specified otherwise.

D. Pump Connections: Flanged.

2.03 IN-LINE CIRCULATORS

A. Type: Maintenance free, self-lubricated, 3 speed industrial/commercial single stage, direct drive circulator.

B. Casing: Cast iron.

C. Impeller: Type 304 stainless steel.

D. Bearings: Upper and lower radial bearings to be aluminum oxide ceramic, tungsten carbide shaft bearing surfaces.

E. Shaft: Stainless steel with type 430F.

2.04 VFD CONTROLLED IN-LINE CIRCULATORS

A. Type: Maintenance free, self-lubricated, pump mounted VFD controlled industrial/commercial single stage, direct drive circulator.

B. Differential pressure monitoring.

C. Casing: Cast iron.

D. Impeller: Type 304 stainless steel.

E. Bearings: Upper and lower radial bearings to be aluminum oxide ceramic, tungsten carbide shaft bearing surfaces.

F. Shaft: Stainless steel with type 430F.

2.05 VERTICAL IN-LINE PUMPS

A. Type: Vertical, single stage, close coupled, for in-line mounting, for 175 psig working pressure.

B. Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: 304 stainless steel.

D. Shaft: 431 stainless steel.

E. Seal: 304 stainless steel with tungsten carbide seal faces and EDPM O-rings.

2.06 BASE MOUNTED PUMPS

A. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 125 psig maximum working pressure.

B. Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Bearings: Permanently lubricated roller or ball bearings.

E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

F. Seal: Carbon rotating against a stationary ceramic seat, viton fitted, 225º F maximum continuous operating temperature.

G. Drive: Flexible coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install pumps in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

D. Decrease from line size with long radius reducing elbows or reducers.

E. Support piping adjacent to pump such that no weight is carried on pump casings. In-line pumps are supported by adjacent piping.

F. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

G. Provide line sized shut-off valve and strainer on pump suction, and line sized combination pump discharge valve on pump discharge.

H. Provide air cock and drain connection on horizontal pump casings.

I. Provide drains for bases and seals, piped to and discharging into floor drains.

J. Lubricate pumps before start-up.

K. Install base mounted pumps on concrete base, with anchor bolts, set and level, and grout in place.

L. Qualified millwright shall check, align, and certify base mounted pumps prior to start-up.

END OF SECTION

SECTION 23 23 00 - REFRIGERATION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Refrigerant Piping.

B. Refrigerant Moisture and Liquid Indicators.

C. Refrigerant Valves.

1.02 RELATED SECTIONS

A. Section 23 05 29 - Hangers and Supports for Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, for placement by this section.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC: Product requirements for Vibration Isolation for placement by this section.

C. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.

D. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.

E. Section 26 05 83 - Wiring Connections: Execution requirements for electric connections specified by this section.

1.03 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 495 - Refrigerant Liquid Receivers.

2. ARI 710 - Liquid-Line Driers.

3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.

4. ARI 750 - Thermostatic Refrigerant Expansion Valves.

5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. American Society of Mechanical Engineers:

1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

3. ASME B31.5 - Refrigeration Piping.

D. ASTM International:

1. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

2. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

2. AWS D1.1 - Structural Welding Code - Steel.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.04 SUBMITTALS

A. Submit shop data under provisions of Division 01.

B. Submit product data indicating general assembly of specialties, including manufacturer’s catalogue information.

C. Submit manufacturer's installation instructions under provisions of Division 01.

D. Submit design data as a submittal under provisions of Division 01.

E. Submit data indicating pipe sizing.

F. Submit test reports under provisions of Division 01.

G. Submit Test reports indicating results of leak test, acid test.

1.05 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Division 01.

B. Accurately record exact locations of equipment and refrigeration accessories on record drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and deliver products to site under provisions of Division 01.

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 PRODUCTS

2.01 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.

1. Fittings: ASME B16.22 wrought copper.

2. Joints: AWS A5.8 BCuP silver braze.

2.02 MANUFACTURERS

A. Alco Controls Div, Emerson Electric Company.

B. Parker Hannifin Corporation.

C. Substitutions: Under provisions of Division 01.

2.03 MOISTURE AND LIQUID INDICATORS

A. Indicators:

1. Port: Single, UL listed.

2. Body: Copper or brass, flared or solder ends.

3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.

4. Maximum working pressure: 500 psig.

5. Maximum working temperature: 200 degrees F.

2.04 VALVES

A. Diaphragm Packless Valves: UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

B. Packed Angle Valves: Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Packed Ball Valves: Two piece [bolted] forged brass Body with Teflon ball seals and copper tube extensions, brass [bonnet and] seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Provide non-conducting dielectric connections when joining dissimilar metals.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Division 01.

I. Insulate piping, refer to Section 23 07 00.

J. Locate expansion valve sensing bulb immediately downstream or evaporator on suction line.

K. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

L. Install flexible connectors at right angles to axial movement of compressor.

M. Fully charge completed system with refrigerant after testing.

N. Provide electrical connection to solenoid valves. Refer to Section 26 05 83.

3.03 APPLICATION

A. Provide line size liquid indicators in main liquid line leaving condenser, or if receiver is provided, in liquid line leaving receiver.

B. Provide line size strainer upstream of each automatic valve. Where multiple expansion valves with integral strainers are used install single main liquid line strainer.

C. Provide shut-off valve on each side of strainer.

D. Provide permanent filter-driers in low temperature systems and systems utilizing hermetic compressors.

E. Provide replaceable cartridge filter-driers vertically in liquid line adjacent to receivers with three valve bypass assembly to permit isolation of driers for servicing.

F. Provide refrigerant charging (packed angle) valve connections in liquid line between receiver shut-off valve and expansion valve.

G. Utilize flexible connectors at or near compressors where within piping configuration does not absorb vibration.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01.

B. Test refrigeration system in accordance with ASME B31.5

C. Pressure test system with dry nitrogen to 200 psig. Perform final tests at 27 inches vacuum and 200 psig using halide torch or electronic leak detector. Test to no leakage.

END OF SECTION

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SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Duct Materials.
2. Duct Fabrication.

1.02 RELATED SECTIONS

A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.

B. Section 23 07 00 - HVAC Insulation: Product requirements for duct liners for placement by this section.

C. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.03 REFERENCES

A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
6. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

1.04 PERFORMANCE REQUIREMENTS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

C. Constant Volume Supply Air Ductwork: Ductwork shall be sheet metal ductwork designed for static pressure class of +2" wg.

D. VAV Supply Air Ductwork Upstream of Terminal Units: Ductwork shall be sheet metal ductwork designed for static pressure class of +4" wg.

E. Supply Air Ductwork Downstream of Terminal Units: Ductwork shall be sheet metal ductwork designed for static pressure class of +2" wg.

F. Return Air Ductwork: Ductwork shall be sheet metal ductwork designed for static pressure class of -2" wg upstream of the fan and +2” wg downstream of the fan.

G. General Exhaust Ductwork: General exhaust ductwork shall include all exhaust ductwork which is not otherwise specified. Ductwork shall be sheet metal ductwork designed for static pressure class of -2" wg upstream of the fan and +2” wg downstream of the fan.

H. Outside Air Ductwork: Ductwork shall be sheet metal ductwork designed for static pressure class of -2" wg.

1.05 SUBMITTALS

A. See General Conditions and the General Requirements in Division 01 regarding submittals.

B. Product Data: Submit data for duct materials, duct liner, duct connectors, fire caulking, and duct sealant.

1.06 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements.

B. Maintain manufacturers requirements for duct sealant temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90/A90M.

B. Fasteners: Rivets, bolts, or sheet metal screws.

C. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic. Maximum VOC content of 75 g/L.

D. Hanger Rod: ASTM A36/A36M; steel; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where

acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence wherever possible. Maximum 30° divergence upstream of equipment and 45°convergence downstream.

E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

F. Use double nuts and lock washers on threaded rod supports.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION

A. Install ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to SMACNA standard duct sealing requirements per pressure construction class.

C. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Install duct hangers and supports in accordance with Section 23 05 29.

E. Use double nuts and lock washers on threaded rod supports.

F. Connect flexible ducts to metal ducts with per SMACNA using adhesive plus sheet metal screws.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

3.04 SCHEDULES

A. Ductwork Material Schedule:

Air System	Material
Supply	Galvanized Steel
Return and Relief	Galvanized Steel
Outside Air Intake	Galvanized Steel
General Exhaust	Galvanized Steel
Combustion Air	Galvanized Steel

END OF SECTION

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Back-draft Dampers.
2. Combination Fire-and-Smoke Dampers.
3. Duct Access Doors.
4. Volume Control Dampers.
5. Flexible Duct Connections.
6. Duct Test Holes.
7. Turning Vanes.
8. Control Dampers.
9. Insulated Control Dampers.

1.02 RELATED SECTIONS

A. Section 23 09 23 - Direct-Digital Control System for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.

B. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.

C. Division 26 - Equipment Wiring Connections: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.03 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

2. NFPA 92A - Recommended Practice for Smoke-Control Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.

2. UL 555S - Standard for Safety for Smoke Dampers.

1.04 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct access doors.

C. Product Data: Submit data for shop fabricated assemblies and hardware used.

D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.

1. Combination Fire-and-Smoke dampers including locations and ratings.

2. Backdraft dampers.

3. Flexible duct connections.

4. Volume control dampers.

5. Duct access doors.

6. Duct test holes.

E. Product Data: For combination fire and smoke dampers submit the following:

1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.

2. Indicate materials, construction, dimensions, and installation details.

3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

F. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of access doors and test holes

C. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.06 QUALITY ASSURANCE

A. Dampers tested, rated and labeled in accordance with the latest UL requirements.

B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

C. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Protect dampers from damage to operating linkages and blades.

C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

D. Storage: Store materials in a dry area indoor, protected from damage.

E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 COORDINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each size and type of fusible link.

1.13 COMPLETION REQUIREMENTS

A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.

2. Contractors One Year Warranty.

3. All Manufacturers' Guarantees.

4. Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.01 BACK-DRAFT DAMPERS

A. Manufacturers:

1. Ruskin.

2. Greenheck.

3. Substitutions: Division 01 - Product Requirements.

B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.

C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel, or extruded aluminum, with center pivoted blades of maximum 6" width, with felt of flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 ACCEPTABLE MANUFACTURERS - COMBINATION FIRE AND SMOKE DAMPERS

A. Greenheck.

B. Ruskin.

C. Pottorff.

D. Substitutions: Under provisions of Division 01.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S, and shall be dynamic type.

B. Fire Resistance: Less than 3 hour rated assemblies: 1-1/2 hour rated; 3 hour or greater rated assembly: 3 hour rated.

C. Smoke Leakage Rating: Class II, maximum of 20 CFM at 4” W.G. differential pressure.

D. Damper Temperature Rating: 250°F.

E. Air Flow Rating: 2,000 FPM.

F. Differential Pressure Rating: 4” W.G.

G. Pressure drop as installed to be 0.1 inches water column or less. Increase damper size as required to meet this condition.

H. Frame: Multiple-blade type; fabricated with roll-formed, 14-gage thick galvanized steel; with mitered and interlocking corners.

I. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application. Furnish silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

J. Blades: Airfoil, horizontal or Vertical interlocking, 14-gauge thick, galvanized sheet steel. In place of interlocking blades, use full-length, 14-gage thick, galvanized-steel blade connectors.

K. Bearings: Self-lubricating, stainless steel pressed into frame.

L. Seals:

1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450°F and galvanized steel for flame seal to 1,900°F. Mechanically attached to blade.

2. Jamb: Stainless steel, flexible metal compression type.

M. Linkage: Blade linkages shall be non-adjustable and concealed within the jamb of the damper.

N. Fusible Link Release Temperature: 165 degrees F, Resettable.

O. Actuator: Two-position action. Mount motor out of air stream. Fail closed type operator, that close damper upon power interruption. 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. Belimo or approved equal.

P. Electrical Connection: 115 V, single phase, 60 Hz.

Q. Accessories:

1. Auxiliary switches: Minimum 1 set one for connection to remote test switch.

2. Remote Test Switch: Test and reset switches, remote mounted, which lights indicating OPEN and CLOSED positions. Switches shall be key operated. Provide wiring harness with sufficient flexibility to allow tile removal in cases where switch is located in ceiling tile. Switch cover plate shall be brushed stainless steel. Locate in ceiling or 7'0" high on wall. Location shall be approved by architect.

2.04 DUCT ACCESS DOORS

A. Manufacturers:

1. Duro-Dyne.

2. Ruskin.

3. Nailor.

4. Substitutions: General Conditions of the Contract - Product Requirements.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

C. Review locations prior to fabrication.

D. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

E. Access doors smaller than 12 inches square may be secured with sash locks.

F. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

G. Access doors with sheet metal screw fasteners are not acceptable.

2.05 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.

C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.

D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends. Where volume dampers are located above gypsum or other non-accessible ceilings, extend damper rods to ceiling and install recessed concealed regulator with adjustable cover for flush installation, with cover. Exposed portions shall be chrome plated. Regulator shall include spring washer, lock nut, coupling, ninety degree screw or gear drive and rod as required, Young Regulator or equal. **Coordinate location of access covers with Architect.**

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.06 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Duro-Dyne.

2. Substitutions: Division 01 - Product Requirements.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

C. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 3 inches wide, crimped into metal edging strip.

2.07 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.08 TURNING VANES

A. Acoustical Vanes: Double width vanes with inner vane of perforated galvanized steel with 3/32 inch holes on 5/32 inch spacing. Fill space between vanes with minimum 1.5 lb/cu ft glass fiber duct liner.

2.09 CONTROL DAMPERS – ACCEPTABLE MANUFACTURERS

A. Manufacturers:

1. Ruskin.

2. Greenheck.

3. Tamco.

4. Substitutions: Division 01 – Product Requirements.

2.10 CONTROL DAMPERS

A. Multi-blade, opposed blade action, control dampers of extruded aluminum, with airfoil type blades of maximum six inch width, blades positioned across short air opening dimension, field replaceable extruded vinyl sealed edges, linked together in rattle-free manner, non-corrosive molded synthetic bearings, square or hexagonal axles for positive locking connection to blades and linkage, with documented leakage rate not to exceed 6 CFM/sq. ft. at 4" W.G.

B. Thermally Broken Control Dampers:

1. Extruded aluminum damper frame shall not be less than .080" in thickness. Damper frame shall be insulated with polystyrofoam on three sides if "Installed in Duct" type and on four sides if "Flanged to Duct" type.

2. Blades to be extruded aluminum profiles, internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29. All blades shall be symmetrically pivoted.

3. Blade seals shall be of extruded EPDM. Frame seals shall be of extruded silicone. Seals to be secured in an integral slot within the aluminum extrusions.

4. Bearings shall be a dual bearing system composed of an inner bearing, rotating within a polycarbonate outer bearing inserted in the frame. Bearings are to be maintenance-free, requiring no lubrication.

5. Control shaft shall have an adjustable length and shall be an integral part of the blade axle.

6. Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

7. Dampers are to be designed for operation in temperatures ranging between -40°F and 185°F.

8. Dampers shall be available with either opposed blade action or parallel blade action. Provide opposed blade dampers for modulating damper applications and parallel blade damper action for open/closed damper applications.

9. Leakage shall not exceed 3 cfm/ft² against 1" w.g. differential static pressure.

10. Dampers shall be AMCA rated for Leakage Class 1A, not to exceed 3 cfm/ft² at 1 in w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

11. Dampers shall be made to size required without blanking off free area.

12. Dampers shall be installed in flanged connection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify rated walls are ready for fire damper installation.

C. Verify ducts and equipment installations are ready for accessories.

D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.02 INSTALLATION.

A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Access Doors: Install access doors at the following locations and as indicated:

1. Before and after each duct mounted filter.

2. Before and after each duct mounted fan.

3. Before and after each automatic control damper.

4. Before and after each combination fire and smoke damper.

5. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96.

D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

E. Install temporary duct test holes as required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

F. Install combination fire and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

1. Install combination smoke and fire dampers in accordance with NFPA 92A.

2. Install dampers square and free from racking with blades running horizontally.

3. Do not compress or stretch damper frame into duct or opening.

4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.

5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.03 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 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.

3.04 DEMONSTRATION

A. Division 01 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

SECTION 23 34 00 - HVAC FANS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Upblast centrifugal roof fans.
2. Inline cabinet fans.

B. Related Sections:

1. Section 23 05 00 - Common Work Results for HVAC.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
3. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
4. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.
5. Section 23 05 93 - Testing, Adjusting and Balancing.
6. Section 23 07 00 - HVAC Insulation.
7. Section 23 09 23 - Direct-Digital Control System for HVAC.
8. Section 23 09 93 - Sequence of Operations for HVAC Controls.
9. Section 23 31 00 - HVAC Ducts and Casings.
10. Section 23 33 00 - Air Duct Accessories.
11. Division 26 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.02 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. American Refrigeration Institute:

1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. Underwriters Laboratories Inc.:

1. UL 705 - Power Ventilators.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of 23 05 00 Common Work Results for HVAC.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01.

B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

D. Balance Quality: Conform to AMCA 204.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 WARRANTY

A. Provide warranty under provisions of Division 01: Product warranties and product bonds.

B. Furnish three years manufacturer’s warranty for fans.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Greenheck Corp.

B. Loren Cook Company.

C. Twin City.

D. Substitutions: Under provisions of Division 01.

2.02 GENERAL

A. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent.

B. Base performance on sea level conditions unless otherwise noted.

C. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

2.03 UPBLAST CENTRIFUGAL ROOF FANS

A. Fan Unit: Upblast type. Direct drive, spun aluminum housing with grease tray; resilient mounted motor; aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.

B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

C. Motor: Electronically commutated variable speed.

D. Accessories:

1. Motor Operated Damper: Aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked and line voltage motor drive, power open, spring return.

2. Roof Curb: 24 inch high self-flashing of galvanized steel construction with continuously welded 1 inch insulation and curb bottom, interior baffle with acoustic insulation, hinged curb adapter, and factory installed nailer strip.

3. Disconnect Switch: Factory wired, NEMA ICS 2, AC general purpose Class A, manually operated unit with number of poles as required by the load served, full-voltage controller for [thermal overload protected] fractional horsepower induction motors with thermal overload unit, NEMA 250 Type 3R enclosure with red pilot light.

2.04 CENTRIFUGAL SQUARE INLINE FANS

A. Product Description: Direct drive with galvanized steel housing lined with 1” acoustic glass fiber insulation, integral inlet cone, removable access doors on 3 sides, inlet and outlet duct collar, gravity backdraft damper in discharge, horizontal hanging brackets.

B. Fan Wheel: Backward inclined centrifugal type, aluminum construction.

C. Motor and Drive Mounting: Out of air stream.

D. Motor: Electronically commutated variable speed.

E. Bearings: ABMA 9 life at 200,000 hours.

F. Accessories:

1. Belt guard.

2. Motor cover.

3. Inlet safety screen.

4. Outlet safety screen.

5. Flexible duct connector.

6. Filter box with throwaway type filter.

7. Disconnect Switch: Factory wired, NEMA ICS 2, AC general purpose Class A, manually operated unit with number of poles as required by the load served, full-voltage controller

for thermal overload protected fractional horsepower induction motors with magnetic starter, NEMA 250 Type 3R enclosure with red pilot light.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof curbs and exhaust hoods are installed and dimensions as instructed by manufacturer.

3.02 PREPARATION

A. Coordinate with other trades for installation of roof curbs. Refer to requirements of Division 07 for installation.

3.03 INSTALLATION

A. Secure roof fans with stainless steel lag screws to roof curb.

B. Suspended Fans: Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Provide backdraft dampers on outlet from ceiling fans and as indicated on Drawings.

D. Install safety screen where inlet or outlet is exposed.

E. Install backdraft dampers on discharge of exhaust fans.

F. Provide sheaves required for final air balance for belt driven fans. Refer to requirements Section 23 05 93.

3.04 DEMONSTRATION

A. Demonstrate fan operation and maintenance procedures.

3.05 PROTECTION OF FINISHED WORK

A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured Chimneys for Gas Fired Equipment.

B. Fabricated Breechings.

C. Manufactured Double Wall Chimneys for Fuel Fired Equipment.

D. Venting for Condensing Appliances.

E. Draft Inducers.

F. Vent Dampers.

1.02 RELATED SECTIONS

A. Section 22 40 00 - Plumbing Equipment.

B. Section 23 05 00 - Common Work Results for HVAC

C. Section 23 05 48 - Vibration and Seismic controls for HVAC

D. Section 23 52 16 - Condensing Boilers.

1.03 REFERENCES

A. ANSI/ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. ANSI/ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

F. ANSI Z21.66 - Electrically Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

G. ANSI Z21.67 - Mechanically Actuated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

H. ANSI Z21.68 - Thermally Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

I. ANSI Z223.1 (NFPA 54) - The National Fuel Gas Code.

J. ASHRAE - Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems."

K. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

M. UL 103 - Standard for Factory Built Low Heat Chimneys.

N. UL 127 - Standard for Factory Built Fireplaces.

O. UL 378 - Standard for Draft Equipment.

P. UL 441 - Standard for Gas Vents.

Q. UL 641 - Standard for Low Temperature Venting Systems.

R. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.04 DEFINITIONS

A. Breeching: Vent Connector.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

B. Design stack supports for wind loading of 110 mph and seismic in accordance with Section 23 05 48.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum three years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to NFPA 54 for installation of natural gas burning appliances and equipment.

1.08 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breeching. Submit layout drawings indicating plan view and elevations.

C. Product Data: Submit data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights and connection requirements.

D. Engineering Data: Submit stack sizing calculations confirming proper stack sizing for the specific equipment used on this project.

E. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication, adjust layout as required to avoid conflict with structure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ICC Chimney.

B. Jeremiahs.

C. Hart & Cooley.

D. Schebler.

E. Van Packer.

F. Substitutions: Under provisions of Division 01.

2.02 HIGH EFFICIENCY CONDENSING BOILER VENTING

A. Provide all accessories for a complete system each bearing factory applied UL label, including but not limited to supports, roof penetrations, appliance connectors, drain fittings and terminations.

B. The factory built modular vent shall be laboratory tested and listed in accordance with Underwriters Laboratories Standard UL 1738 for use with category II, III, & IV appliances with a

maximum flue gas temperature of 550°F and ULC-S636-95 for gas vent - BH, Class I / Class II 245°C.

C. Vent sections shall be sealed with ½" banded flanges and silicone joint sealant for temperatures up to 600°F with a UL tested pressure rating of 40" w.c.

D. Inner shell material shall be type AL 29-4C® stainless steel. Inner shell thickness shall be 20 gauge. All inner shell seams shall be full penetration welded. Riveted, tack or spot welded seams are not permitted.

E. Outer shell material shall be aluminized steel with a thickness of .034", outer shell material can be 304 or 316 stainless steel. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted.

F. There shall be a minimum 2" of 1600°F rated low conductivity ceramic fiber insulation between the inner and outer shells. The insulation is to be securely attached to the inner shell with steel straps and insulating pins welded to the inner shell. Stainless steel centering clips shall be welded to the outer shell to maintain the 2” spacing and ensure concentricity of the shells.

G. Breeching and vent sections, when installed according to manufacturer's instructions, shall comply with national safety standards and building codes. Stacks terminating above a roof must terminate as required by code or NFPA 211.

H. Venting shall be designed to drain to boiler condensate treatment tanks.

2.03 WATER HEATER VENTING

A. Polypropylene vent pipe for use with ANSI Category II and IV gas burning appliances, including tankless and storage water heaters, high-efficiency water heaters, condensing boilers and warm air furnaces. PolyPro shall be listed by Intertek to the ULC S636 standard in Canada and is rated as a Class IIA, IIB and IIC vent system suitable for exhaust temperatures up to 230F / 110C, and a maximum positive pressure of 15 in-w.c. Duravent PolyPro Commercial or approved equal.

B. Provide all accessories for a complete system including but not limited to supports, flashings, termination cap, etc.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide double wall, insulated vent continuous from appliance outlet to exterior termination. Vent shall be sloped to drain to appliance condensate treatment tank. Provide all necessary connections and additional piping as required to allow system to drain to condensate treatment tanks where slope cannot be maintained.

C. Install in accordance with recommendations of ASHRAE -Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems", and NFPA 54.

D. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

E. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

G. For all double wall vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

H. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement to ANSI/ASTM C105. Connect base section to foundation using anchor lugs.

I. Level and plumb chimney and stacks.

J. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

K. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, chimneys, or stacks.

L. No single wall vent connectors or breechings are permitted.

END OF SECTION

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SECTION 23 52 16 - CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Condensing Gas Boilers.

B. Controls and Boiler Trim.

1.02 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

D. Section 23 05 48 - Vibration and Seismic controls for HVAC.

E. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

F. Section 23 09 23 - Direct Digital Control System for HVAC.

G. Section 23 09 93 - Sequence of Operation.

H. Section 23 21 13 - Hydronic Piping.

I. Section 23 21 16 - Hydronic Piping Specialties.

J. Section 23 51 00 - Breechings Chimneys and Stacks.

K. Section 26 05 83 - Wiring Connections.

1.03 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.13 - Gas-fired Low Pressure Steam and Hot Water Boilers.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

1. ASME Section IV - Boiler and Pressure Vessel Code - Heating Boilers.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
3. ASME CSD-1 (Controls and Safety Devices).

D. Hydronics Institute:

1. H.I. Heating Boiler Standard - Testing and Rating Standard for Heating Boilers.

E. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.

1. Prior to flue vent installation, engineered calculations and drawings must be submitted to Architect/Engineer to thoroughly demonstrate that size and configuration conform to recommended size, length and footprint for each submitted boiler.

C. Efficiency Curves: At a minimum, submit efficiency curves for 100%, 60%, and 5% input firing rates at incoming water temperatures ranging from 60°F to 160°F. Test protocols shall conform to AERCO’s AE 1 standards and shall be witnessed and reviewed by an independent, third party group.

D. Pressure Drop Curve: Submit pressure drop curve for flows ranging from 0 GPM to maximum value of boiler.

1. If submitted material is different from that of the design basis, boiler manufacture shall incur all costs associated with reselection of necessary pumps. Possible differences include, but are not limited to, the pump type, pump pad size, electrical characteristics and piping changes.

E. Shop Drawings: For boilers, boiler trim and accessories, include:

1. Plans, elevations, sections, details and attachments to other work.
2. Wiring Diagrams for power, signal and control wiring.

F. Source Quality Control Test Reports: Reports shall be included in submittals.

G. Field Quality Control Test Reports: Reports shall be included in submittals.

H. Submit data showing boiler burner, controls and boiler control panel wiring.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

C. Include reports from manufacturers field service testing.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. The equipment shall, at a minimum, 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, appurtenances, 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.

C. The equipment shall be of the type, design, and size that the manufacturer currently offered for sale and appears in the manufacturer's current catalogue. The equipment shall be new and fabricated from new materials and shall be free from defects in materials and workmanship.

D. All units of the same classification shall be identical to the extent necessary to insure interchangeability of parts, assemblies, accessories, and spare parts wherever possible.

E. 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. The boiler manufacturer shall be responsible for guarantying that the boiler provides the performance as specified herein.

1.07 CERTIFICATIONS

A. Manufacturer's Certification: The boiler manufacturer shall certify the following:

1. The products and systems furnished are in strict compliance with the specifications.

2. The boiler, burner and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable boiler.

3. ASME certification.

4. UL certification.

5. The specified factory tests have been satisfactorily performed.

6. The specified field tests have been satisfactorily performed.

B. Contractor's Certification: The contractor shall certify the following:

1. The products and systems installed are in strict compliance with the specifications.

C. Boiler Inspectors' Certification: All boiler inspections during hydrostatic testing shall be performed by an authorized boiler inspector who is certified by the National Board of Boiler and Pressure Vessel Inspectors and shall be submitted in writing prior to final acceptance by the engineer.

1.08 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

B. Conform to ANSI/ASME SEC4 and SEC 8D for boiler construction.

C. Units: AGA certified. UL labeled.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store. and protect products to site under provisions of Division 01.

B. Accept boilers and accessories on site in factory shipping packaging. Inspect for damage.

C. Protect boilers from damage by leaving packing in place until installation.

D. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.10 WARRANTY

A. Provide one year warranty for the entire boiler under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Aerco.

B. Substitutions: Under provisions of General Conditions in Division 01.

2.02 HIGH EFFICIENCY CONDENSING BOILERS

A. Boiler shall be natural gas fired, fully condensing, fire tube design. Power burner shall have full modulation (the minimum firing rate shall not exceed 100,000 BTU/HR input. Boilers that have an input greater than 100,000 BTU/Hr at minimum fire will not be considered) and discharge into a positive pressure vent. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Boiler shall be factory-fabricated, factory-assembled and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return and condensate drain connections, and controls.

B. Heat Exchanger: The heat exchanger shall be constructed of 439 stainless steel fire tubes and tubesheets, with a one-pass combustion gas flow design. The fire tubes shall be 5/8" OD, with no less than 0.049" wall thickness. The upper and lower stainless steel tubesheet shall be no less than 0.25" thick. The pressure vessel/heat exchanger shall be welded construction. The heat exchanger shall be ASME stamped for a working pressure not less than 160 psig. Access to the tubesheets and heat exchanger shall be available by burner and exhaust manifold removal. Minimum access opening shall be no less than 10-inch diameter.

C. Pressure Vessel. The pressure vessel shall have a maximum water volume of 40 gallons. The boiler water pressure drop shall not exceed 4 psig at 258 gpm. The boiler water connections shall be 4-inch flanged 150-pound, ANSI rated. The pressure vessel shall be constructed of SA53 carbon steel, with a 0.25 inch thick wall and 0.50-inch thick upper head. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.

D. Modulating Air/Fuel Valve and Burner. The boiler burner shall be capable of a 20-to-1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 20 ppm of NOx corrected to 3% excess oxygen. The burner shall be metal fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. A variable frequency drive (VFD), controlled cast aluminum pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.

E. Exhaust Manifold: The exhaust manifold shall be of corrosion resistant cast aluminum or 316 stainless steel with an 8 inch diameter flue connection. The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.

F. Blower: The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

G. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

H. Gas train: Supply boilers with FM Approved Gas Train and gas pressure regulator.

I. Motorized Valve: Provide boiler with 4” motorized isolation valve, rated for 50 psi, ANSI flange, actuator compatible with boiler control system.

J. Electrical requirements: Provide single point connection for each unit for all 120v single phase and 24V low voltage power requirements.

K. The boiler control system shall be segregated into three components: "C-More" Control Panel, Power Box and Input/Output Connection Box. The entire system shall be Underwriters Laboratories recognized.

L. The control panel shall consist of six individual circuit boards using state-of-the-art surface-mount technology in a single enclosure. These circuit boards shall include:

1. A display board incorporating LED display to indicate temperature and a vacuum fluorescent display module for all message enunciation.

2. A CPU board housing all control functions.

3. An electric low-water cutoff board with test and manual reset functions.

4. A power supply board.

5. An ignition /stepper board incorporating flame safeguard control.

6. A connector board.

7. Each board shall be individually field replaceable.

M. The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.

N. The control panel hardware shall support both RS-232 and RS-485 remote communications for Modbus interface to the DDC system, coordinate with Section 23 09 93.

O. The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities that incorporate a minimum of eight separate status messages and 34 separate fault messages.

P. The control panel shall incorporate three self-governing features designed to enhance operation in modes where it receives an external control signal by eliminating nuisance faults due to over-temperature, improper external signal or loss of external signal. These features include:

1. Setpoint high limit: Allows for a selectable maximum boiler outlet temperature and acts as temperature limiting governor. Setpoint limit is based on a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degree selectable band from the desired maximum boiler outlet temperature.

2. Setpoint Low Limit: Allows for a selectable minimum operating temperature.

3. Failsafe Mode: Failsafe mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can to shut off the unit upon loss of external signal, if so desired.

Q. The boiler control system shall incorporate the following additional features for enhanced external system interface:

1. System start temperature feature.

2. Pump delay timer.

3. Auxiliary start delay timer.

4. Auxiliary temperature sensor.

5. Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate.

6. Remote interlock circuit.

7. Delayed interlock circuit.

8. Fault relay for remote fault alarm.

R. Each boiler shall include an electric, single-seated combination safety shutoff valve/regulator with proof of closure switch in its gas train. Each boiler shall incorporate dual over-temperature protection with manual reset, in accordance with ASME Section IV and CSD 1.

S. Each boiler shall have an oxygen monitoring system that will measure the oxygen content of the exhaust gasses in real-time. Output of O2 information shall be displayed on the C-More control panel.

T. Each boiler shall have integrated Boiler Sequencing Technology (BST), capable of multi-unit sequencing with lead-lag functionality and parallel operation. The system will incorporate the following capabilities:

1. Efficiently sequence 2-to-8 units on the same system to meet load requirement.

2. Integrated control and wiring for seamless installation of optional isolation valve. When valves are utilized, the system shall operate one motorized valve per unit as an element of load sequencing. Valves shall close with decreased load as units turn off, minimum of one must always stay open for recirculation.

3. Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load in an effort to equalize unit run hours.

4. Designated master control, used to display and adjust key system parameters.

5. Automatic bump-less transfer of master function to next unit on the chain in case of designated master unit failure; master/slave status should be shown on the individual unit displays.

6. Designated master control, used to display and adjust key system parameters.

U. Factory-installed and factory-wired switches, motor controllers, transformers and other electrical devices shall provide a single-point field power connection to the boiler.

V. The contractor shall supply and install fire side condensate neutralizing tubes for each boiler condensate drain and all flue pipe condensate drain connections. The condensate tubes shall be designed to elevate the PH level of the boiler and flue condensate to a minimum of 3 PH above the boiler and flue condensate PH level or between 6.2 and 7.2 PH. The tubes shall be sized per manufacturer's recommendation. Neutralizer Agent: 1/2" to 3/4" aggregate calcium carbonate, provide initial fill and 50 lbs. extra stock.

2.03 HIGH EFFICIENCY CONDENSING BOILER VENTING

A. Unit venting shall be UL Listed for use with Category III and IV appliances. Vent material shall be AL-294C stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in strict accordance with manufacturer's installation instructions.

B. Install equipment in strict compliance with state and local codes and applicable NFPA standards.

C. Maintain manufacturer's recommended clearances around sides and over top of equipment.

D. Install components that were furnished loose with equipment for field installation.

E. Provide all interconnecting electrical control and power wiring. Provide for connection to electrical service.

F. Provide all piping for boiler pipe connections.

G. Pipe relief valves to 6” above finished floor.

H. Pipe condensate drains to acidic condensate neutralizer. Provide p-trap upstream of neutralizer. All piping shall be PVC and supplied/installed by the contractor. Plastic tubing is an acceptable alternative when used with barbed fittings. All PVC joints shall be glued in place and all barbed fittings shall be secured with tie wraps. All neutralizing tubes shall be secured to the floor or wall so as not to be exposed to damage or within a normal walkway. The contractor shall fill all "P-traps" and neutralizing tubes with tap water before the firing of any boiler.

3.02 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 01. Instruct operating personnel.

B. Submit written report after start-up including control settings and performance chart of control system.

C. Coordinate all work with Specification Section 23 09 23 and 23 09 93. Perform start-up in conjunction with testing of BAS systems to insure interface between boiler controls and BAS controls are complete and fully functional. Verify system operation in accordance with the sequence of operation.

D. Commission Boilers per manufacturer's recommendations provide field start-up service by factory certified boiler technician.

E. Equipment inspection: Boiler manufacturer's representative to provide jobsite assistance to inspect boilers and other equipment verifying completeness of equipment supplied. Casing, insulation and boiler mounted controls shall ship loose for field assembly by Manufacturer's Representative after boiler has been set and mounted on legs by installing contractor. Installing contractor shall provide laborer for assistance.

F. Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the boiler supplier, and shall include the following:

1. Demonstrate that boiler, burner, controls and accessories comply with requirements of this Section as proposed by the boiler and accessories supplier. Pre-test all items prior to scheduling the final testing that will be witnessed by the test engineer.

2. Readings at different firing rates (20, 50, 75 and 100%) of load for the modulating burner shall be taken with a written report of the tests submitted to the engineer. The reports shall include readings for each firing rate tested and shall include stack temperatures, O2, CO, NOx, and overall boiler efficiency.

3. Auxiliary Equipment and Accessories: Observe and check all valves, draft fans and electric motors, as well as other accessories and appurtenant equipment during the

operational and capacity tests for leakage, malfunctions, defects, and non-compliance with referenced standards or overloading as applicable.

G. Substantial Completion Demonstration Requirements:

1. Fireside inspection.
2. Set up fuel train and combustion air system.
3. Set up operating set points.
4. Check all safeties, including: Flame safeguard, LWCO, ALWCO, Air flow, Fuel pressures, High limits.
5. Set up and verify efficiencies at 20%, 50%, 75%, and 100%.
6. Set up and verify burner turndown.
7. Training to include all safety procedures, maintenance procedures, control operations, and diagnostic procedures. Training to be provided in a single 4 hour continuous session to accommodate operator's availability on site.

H. Submit written report after start-up including control settings and performance chart of control system.

END OF SECTION

SECTION 23 57 00 - HEAT EXCHANGERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Brazed Plate Heat Exchangers.

B. Accessories and Trim.

1.02 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 21 13 - Hydronic Piping.

C. Section 23 21 16 - Hydronic Specialties.

D. Section 23 05 19 - Meters and Gauges for HVAC piping.

1.03 REFERENCES

A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.04 REGULATORY REQUIREMENTS

A. Conform to Section 8D of the ANSI/ASME Boilers and Pressure Vessels Code for manufacture of tubular heat exchangers and heat exchanger shells.

1.05 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Indicate dimensions, locations, and size of tappings and performance data.

C. Submit manufacturer's installation instructions under provisions of Division 01.

D. Submit design data in sufficient detail to verify that heat exchangers meet or exceed specified requirements.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include start up and shut down instructions, assembly drawings, and spare parts lists.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Protect internals from entry of foreign material by temporary caps on flanged openings.

PART 2 PRODUCTS

2.01 MANUFACTURERS – BRAZED PLATE TYPE HEAT EXCHANGERS

A. Alfa-Laval.

B. Bell & Gossett.

C. Danfoss.

D. Hexonic.

E. Kelvion.

F. ONDA Advanced Heat Exchangers.

G. Taco.

H. Tranter.

I. Substitutions: Under provisions of Division 01.

2.02 BRAZED PLATE TYPE HEAT EXCHANGER

A. Plates: Stainless steel Type 316L, vacuumed brazed together with high temperature copper braze, ASME Certified

B. Nozzles: Threaded connections.

C. Maximum working pressure 150 psig, maximum working temperature 350 Degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Support heat exchangers on welded steel pipe and angle floor stand.

C. Pipe relief valves to nearest floor drain or glycol tank.

D. Pipe drain valves to nearest floor drain.

3.02 WATER TO WATER HEAT EXCHANGER TRIM

A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.

B. Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure relief valve, valved drain.

END OF SECTION

SECTION 23 63 00 - REFRIGERANT CONDENSERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Condensing Unit Package.

B. Internal Piping and Accessories.

C. Controls.

D. Charge of Refrigerant and Oil.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

D. Section 23 05 48 - Vibration and Seismic controls for HVAC.

E. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

F. Section 23 09 23 - Direct Digital Control System for HVAC.

G. Section 23 09 93 - Sequence of Operation.

H. Section 23 23 00 - Refrigerant Piping.

I. Section 23 73 00 - Indoor Central Air-Handling Units.

J. Section 26 05 83 - Wiring Connections.

1.03 QUALITY ASSURANCE

A. Conform to requirements of UL and applicable codes.

B. Test and rate cooling system to ARI Standard 210.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01.

B. Submit with shop drawings, schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.

C. Submit complete pipe sizing data.

D. Submit manufacturer's installation instructions under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Trane.

B. Substitutions: Under provisions of Division 01.

2.02 CONDENSING UNITS

A. Provide packaged, factory assembled, prewired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.

2.03 MATERIALS

A. Use corrosion resistant materials for parts in contact with refrigerant.

B. Provide timer circuits to prevent rapid loading and unloading of compressor.

2.04 CABINET

A. Galvanized steel with baked enamel finish, and removable access doors or panels with quick fasteners.

2.05 COMPRESSOR

A. Provide hermetically sealed, 1750 rpm, resiliently mounted compressor with positive lubrication, crankcase heater, cylinder unloaders for capacity modulation, motor overload protection, service valves, and filter drier.

2.06 CONDENSER

A. Coil: Seamless copper tubing with aluminum fins.

B. Fans: Vertical discharge, direct drive axial fans, resiliently mounted with guard and motor.

C. Motors: Permanently lubricated ball bearing motors with built-in current and overload protection.

2.07 CONTROLS

A. Provide factory wired and mounted control panel containing fan motor contactors, fan cycling thermostats, head pressure damper controls, compressor interlock and control transformer.

B. Provide high and low pressure cutouts for compressor, oil pressure control, non-recycling pump-down, and reset relay.

C. Provide controls to permit operation down to -15 ºF ambient temperature at minimum compressor load.

PART 3 EXECUTION

3.01 INSTALLATION

A. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.

B. Furnish charge of refrigerant and oil.

3.02 ADJUSTING

A. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period. Supply to Owner, one complete charge of lubricating oil in addition to that placed in the system.

B. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

C. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

D. Provide cooling season start-up, and winter season shut-down for first year of operation.

E. Inspect and test for refrigerant leaks every during first year of operation.

END OF SECTION

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SECTION 23 73 00 - INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Indoor Central-Station Air-Handling Units.

1.02 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

D. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

E. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

F. Section 23 09 23 - Direct Digital Control System for HVAC.

G. Section 23 21 16 - Hydronic Piping Specialties.

H. Section 23 31 00 - HVAC Ducts and Casings.

I. Section 23 33 00 - Air Duct Accessories.

1.03 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.

F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

G. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

H. ANSI/UL 900 - Test Performance of Air Filter Units.

I. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

J. ARI 430 - Standard for Central-Station Air-Handling Units.

K. ARI 435 - Standard for Application of Central-Station Air- Handling Units.

L. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

M. SMACNA - Low Pressure Duct Construction Standards.

1.04 QUALITY ASSURANCE

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

D. Filter Media: ANSI/UL 900 listed, Class I or Class II, approved by local authorities.

E. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

F. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit sound power levels for both fan outlet and casing radiation at rated capacity.

F. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

G. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

H. Submit manufacturer's installation instructions under provisions of Division 01.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.

B. Store and protect products under provisions of Division 01.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.09 EXTRA STOCK

A. Provide one set of disposable panel filters under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Trane.

B. Substitutions: Under provisions of Division 01.

2.02 GENERAL

A. Fabricate draw-through type air handling units suitable for medium pressure operation.

B. Fabricate units with fan or fan and coil section plus accessories, including heating coil, mixing box section, pre-filter section, final filter section, and cooling coil section.

C. Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified.

D. Base performance on sea level conditions.

2.03 AIR HANDLING UNIT

A. Refer to air handling unit schedule on mechanical drawings for basis of design model numbers. Provide specified model and accessories or equivalent product from the acceptable manufacturers listed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and in conformance with ARI 435.

B. Assemble high pressure units by bolting sections together.

END OF SECTION

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SECTION 23 74 00 - PACKAGED OUTDOOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged Roof Top Unit.

B. Unit Controls.

C. Remote Panel.

D. Roof Mounting Frame and Base.

E. Maintenance Service.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 26 05 83 - Wiring Connections: Installation and wiring of thermostats and other controls components.

B. Section 26 05 83 - Wiring Connections: Final connection of wiring from unit terminal strip to remote panel.

1.03 RELATED SECTIONS

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

B. Section 23 07 00 - HVAC Insulation.

C. Section 23 09 00 - Instrumentation and Control for HVAC.

D. Section 23 21 23 - Hydronic Pumps.

E. Section 26 05 83 - Wiring Connections: Electrical supply to units.

1.04 REFERENCES

A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. ARI 210 - Unitary Air-Conditioning Equipment.

C. ARI 240 - Air Source Unitary Heat Pump Equipment.

D. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

1.05 SUBMITTALS

A. Submit product data for manufactured products and assemblies required for this project.

B. Indicate electrical service and duct connections on product data.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.08 WARRANTY

A. Provide one year manufacturer's warranty under provisions of Division 01.

B. Warranty: Include coverage of refrigeration compressors.

1.09 EXTRA MATERIALS

A. Provide one set of disposable filters.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trane.

B. Substitutions: Under provisions of Division 01.

2.02 MANUFACTURED UNITS

A. Provide roof-mounted units having hydronic heating coils, packaged condenser coil and fan, pre-filters, final filters, controls, and plenum supply fans. Unit shall be self-contained, packaged, factory assembled, and pre-wired.

B. Refer to roof top unit schedules on mechanical drawings for basis of design model numbers. Provide specified model and accessories or equivalent product from the acceptable manufacturers listed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as illustrated by the manufacturer.

B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting frame level.

3.03 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

END OF SECTION

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SECTION 26 01 26 - MAINTENANCE TESTING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Feeder Megohm Testing.

B. Receptacle Branch Circuit Testing.

C. Ground Fault Circuit Interrupter Testing.

D. Phase Rotation.

E. Additional Testing and Maintenance Requirements in Individual Equipment and System Sections.

1.02 REFERENCES

A. NETA ATS 2021 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. ANSI/IEEE Std 81-1983 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.03 SUBMITTALS

A. Submit data under provisions of Division 01 and Section 26 05 00.

B. Product Data: Submit technical information for each test instrument to include manufacturer, model number, serial number, ratings, accuracy, and National Institute of Standards and Technology (NIST) Traceable calibration certification.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit Test Reports per Section 26 05 00.

1.05 COORDINATION

A. Provide written 72 hours advance notice of all tests to be performed to allow Owner's Representative to witness testing.

1.06 REQUIRED TEST INSTRUMENTS

A. MEGOHMMETER.

1. Product Description: 1000 Volt DC, portable, insulation and resistance test Megohmmeter.

2. Equipment Accuracy:

a. 2000 Megohm Range - 3% of full Scale.

B. BRANCH CIRCUIT ANALYZER

1. Product Description: Branch circuit analyzer capable of receptacle testing of voltage drop under load, hot-neutral-ground conductor impedances, common mode (N-G) Voltage, and G.F.C.I. trip point.

2. Manufacturer: Ideal SureTest. Model: 61-164 Circuit Analyzer or approved equal.

3. Equipment Accuracy:

a. AC Voltage and Frequency accuracy: 1% full scale ± 1 digit True RMS.

b. Impedance 0.00 – 1.99 Ohms: 5.0% accuracy.

c. Ground-Neutral Voltage 0.0 – 24.0V: 2.0% accuracy.

d. % Voltage Drop 12A, 15A, 20A load tests: 5.0% accuracy.

e. GFCI Test Current/Time 6.0 – 9.0mA/0.00 – 6500mS: 2% accuracy.

C. MULTIMETER

1. Product Description: Digital True RMS Multimeter.

2. Equipment Accuracy:

a. AC Voltage Range: 0.75% ± 3 last single digits at 60 Hz.

b. AC Current Range: 0.90% ± 3 last single digits at 60 Hz.

c. DC Voltage Range: 0.25% ± 1 last single digit.

d. DC Current Range: 0.75% ± 1 last single digit.

e. Resistance Ranges: 0.50% ± 1 last single digit.

f. Frequency Range: 0.10% ± 1 last single digit @ 60 Hz.

1.07 TEST INSTRUMENT CALIBRATION

A. All test equipment shall be in good mechanical and electrical condition.

B. Provide calibration for each test instrument directly traceable to the National Institute of Standards and Technology (NIST) of higher accuracy than that of the instrument tested.

C. Provide calibration labels visible on all test equipment. Records, which show date and results of instruments calibrated or tested, shall be kept up-to-date.

D. Calibrate instruments in accordance with the following frequency schedule:

1. Field instruments: 12 months maximum.

2. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument with the equipment.

1.08 MINIMUM REPORT INFORMATION

A. Report Criteria: After each test, promptly submit one copy of report to the Owner's Representative. [Include information on the ASD report form where included within this specification otherwise] provide form with the minimum following information:

1. Date issued.
2. Project title and number.
3. Name and Model of Tester and witnesses.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Type of inspection or test.
7. Date of test.
8. Results of tests.
9. Indicate compliance or non-compliance with Contract Documents.
10. Final adjustment setting values where applicable.

B. Submit copy of all tests performed in the O&M manual.

1.09 GENERAL REQUIREMENTS

A. Include a copy of each test result in the O&M manual.

B. Provide qualified personnel at site to perform all testing.

C. Perform specified testing of products in accordance with specified standards or as denoted in this specification whichever is more stringent.

D. Promptly notify Owner's Representative of irregularities or non-conformance of Work or products.

E. Perform additional tests when test is performed incorrectly, deemed inaccurate, or incorrectly documented.

F. The Contractor shall provide all forms, instrumentation and test equipment, loads, and other consumables required to demonstrate the systems to Owner's Representative satisfaction.

G. Perform and submit all testing prior to substantial completion and system acceptance.

H. Retest all material, cables etc. that are disturbed after testing.

I. Replace and retest all material installed which does not meet or exceed the minimum acceptable limits set forth in this specification in accordance with the contract original requirements at no additional charge to Contract Sum/Price.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 FEEDER CONDUCTOR TEST

A. Tests Criteria:

1. Use Megohm meter to test all conductors sized #6AWG and larger.

2. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential 1000 volts DC for 600 volt rated cable.

3. Perform test immediately after installation.

4. Clean exposed cable ends with clean cloth and alcohol.

5. Test duration shall be one minute.

6. Disconnect conductors from all equipment.

7. Record the resistance of the insulated conductor under test with all other conductors connected together and to ground (metallic raceway, grounding conductor, etc.).

8. Perform continuity test to insure correct cable connection.

   a. Submit test results to Owner’s Representative.

B. Test Values:

1. Minimum insulation-resistance value: 100 megohms.

2. Investigate deviations between adjacent phases.

3.02 RECEPTACLE GROUND FAULT CIRCUIT INTERRUPTER TEST

A. Test Criteria:

1. Use Branch Circuit Analyzer to perform test of each GFCI protected receptacle.

2. Record trip level in ma for each outlet.

3. Submit test results to Owner's Representative.

B. Test Values:

1. Trip Range: Between 6-9 mA.

3.03 PHASE ROTATION TEST

A. Test each three-phase circuit and feeder for consistent phase rotation for the entire power system with a phase rotation meter.

B. Bump test each motor for proper rotation prior to use.

C. Correct conductor phase relationship to provide proper phase rotation.

D. Record the rotation sequence on each panelboard, MDP and Service circuit schedule.

E. Submit test results of each panelboard, MDP and Service to the Owner's Representative.

3.04 PHASE LOAD BALANCE TEST

A. After energizing building loads conduct a phase load balance test for each new or remodeled panelboard with a clamp on ammeter.

B. Shift loads to provide current balance within 20% of the other phases. Revise circuit directory and all conductor labels to reflect any changes.

C. Notify Owner's Representative at least 72 hours in advance before test.

END OF SECTION

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General Requirements specifically applicable to Division 26, in addition to Division 01 provisions.

B. The electrical system equipment and installation shall comply with all provisions and requirements of this specification, as well as any and all applicable national, state and local codes and standards.

1.02 WORK SEQUENCE

A. Construct Work in sequence under provisions of Division 01.

1.03 COORDINATION

A. Coordinate the Work specified in this Division under provisions of Division 01.

B. Prepare drawings showing proposed rearrangement of Work to meet job conditions, including changes to Work specified under other Sections. Obtain permission of Architect prior to proceeding.

1.04 FUTURE WORK

A. Provide for future work under requirements of Division 01.

1.05 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code, latest adopted edition including all state and local amendments.

B. NECA - Standard of Installation.

C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. Electrical Reference Symbols: The Electrical "Legend" on drawings is standardized version for this project. All symbols shown may not be used on drawings. Use legend as reference for symbols used on plans.

E. Electrical Drawings: Drawings are diagrammatic; complimentary to the Architectural drawings; not intended to show all features of work. Install material not dimensioned on drawings in a manner to provide a symmetrical appearance. Do not scale drawings for exact equipment locations. Review Architectural, Civil, Structural, and Mechanical Drawings and adjust work to

conform to conditions shown thereon. Field verification of dimensions, locations and levels is directed.

1.06 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70.

B. Conform to the latest adopted edition of the International Building Code and the International Fire Code including all state and local amendments thereto.

C. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.07 SUBMITTALS

A. Submittal review is for general design and arrangement only and does not relieve the Contractor from any requirements of Contract Documents. Submittal not checked for quantity, dimension, fit or proper operation. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provisions of a complete and satisfactory working installation are the sole responsibility of the Contractor.

B. In addition to requirements referenced in Division 01, the following is required for work provided under this division of the specification.

1. Provide material and equipment submittals containing complete listings of material and equipment shown on Electrical Drawings and specified herein. Separate from work furnished under other divisions.

2. Submittals shall be provided in PDF format with each section indexed in the PDF document. Submittals for Division 26 shall be complete and submitted at one time. Unless given prior approval, partial submittals will be returned unreviewed.

3. Clearly identify all material and equipment by item, name or designation used on drawings and in specifications.

4. Submit only pages which are pertinent; mark catalog sheets to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring diagrams and controls; component parts; finishes; dimensions; and required clearances.

5. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

6. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.

7. Coordinate submittals with requirements of work and of Contract Documents.

8. Certify in writing that the submitted shop drawings and product data are in compliance with requirements of Contract Documents. Notify Architect/Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.

9. Do not fabricate products or begin work which requires submittals until return of submittal with Architect/Engineer acceptance.

10. Equipment scheduled by manufacturer's name and catalog designations, manufacturer's published data and/or specification for that item, in effect on bid date, are considered part of this specification. Approval of other manufacturer's item proposed is contingent upon compliance therewith.

1.08 SUBSTITUTIONS

A. In accordance with the General Conditions and the General Requirements, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

1.09 PROJECT RECORD DRAWINGS

A. Maintain project record drawings in accordance with Division 01.

B. In addition to the other requirements, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.

C. Record drawing field mark-ups shall be maintained on-site and shall be available for examination of the Owner’s Representative at all times.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals for training of Owner's Representative in operation and maintenance of systems and related equipment. In addition to requirements referenced in Division 01, the following is required for work provided under this section of the specifications.

B. Manuals shall be separate from work furnished under other divisions. Prepare a separate chapter for instruction of each class of equipment or system. Index and clearly identify each chapter and provide a table of contents.

C. Unless otherwise noted in Division 01, provide one copy of all material for approval.

D. The following is the suggested outline for operation and maintenance manuals and is presented to indicate the extent of items required in manuals.

1. List chapters of information comprising the text. The following is a typical Table of Contents:

a. Electrical power distribution.

b. Lighting.

c. Fire alarm.

d. Other chapters as necessary.

2. Provide the following items in sequence for each chapter shown in Table of Contents:

a. Describe the procedures necessary for personnel to operate the system including start-up, operation, emergency operation and shutdown.

1) Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable.

2) Give step-by-step instructions for shutdown procedure if a particular sequence is required.

3) Include test results of all tests required by this and other sections of the specifications.

b. Maintenance Instructions:

1) Provide instructions and a schedule of preventive maintenance, in tabular form, for all routine cleaning and inspection with recommended lubricants if required for the following:

a) Lighting fixtures.

b) Distribution equipment.

c) Fire alarm and detection equipment.

2) Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which requires no special training or skills.

3) Provide manufacturers' descriptive literature including approved shop drawings covering devices used in system, together with illustrations, exploded views, etc. Also include special devices provided by the Contractor.

4) Provide any information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.

5) Include list of all equipment furnished for project, where purchased, technical representative if applicable and a local parts source with a tabulation of descriptive data of all electrical-electronic spare parts and all mechanical spare parts proposed for each type of equipment or system. Properly identify each component by part number and manufacturer.

c. Inspection Certificate: Include copy of certificate of final inspection and acceptance from the Authority Having Jurisdiction.

1.11 DEMONSTRATION OF ELECTRICAL SYSTEMS

A. During substantial completion inspection:

1. Conduct operating test for approval under provisions of Division 01.

2. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.

3. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.

4. Have instruments available for measuring light intensities, voltage and current values, and for demonstration of continuity, grounds, or open circuit conditions.

5. Provide personnel to assist in taking measurements and making tests.

1.12 WARRANTY

A. In addition to the requirements of Division 01, or as specified in other sections. Warrant all materials, installation and workmanship for one (1) year from date of acceptance.

B. Copies of manufacturer product warranties for all equipment shall be included in the operation and installation manuals.

1.13 INSTRUCTION OF OPERATING PERSONNEL

A. In accordance with the requirements of Division 01 and this section provide services of qualified representative of supplier of each item or system listed below to instruct designated personnel of Owner in operation and maintenance of item or system.

B. Certify that an Anchorage based authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address and telephone number of service organization.

C. Have approved operation and maintenance manuals and parts lists for all equipment on hand at time of instruction.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All Materials and Equipment shall be new.

B. All Materials and Equipment shall be listed by Underwriter's Laboratories or equivalent third party listing agency for the use intended.

C. Materials and Equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended when installed per listing and labeling instructions.

D. No materials or equipment containing asbestos in any form shall be used. Where materials or equipment provided by this Contractor are found to contain asbestos such items shall be removed and replaced with non-asbestos containing materials and equipment at no cost to the Owner.

E. In describing the various items of equipment, in general, each item will be described singularly, even though there may be numerous similar items.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Install Work using procedures defined in NECA Standard of Installation and/or the manufacturer's installation instructions.

3.02 TESTS

A. Perform tests in accordance with Section 26 01 26 – Maintenance Testing of Electrical Systems.

B. Notify the Owner’s representative at least 72 hours prior to conducting any tests.

C. Following completion of installation, test system ground in accordance with the requirements of NETA ATS 7.13. and all feeders in accordance with NETA ATS 7.3. Submit logs of values obtained, and nameplate data of instruments used prior to final inspection. Include a copy of all data in the power distribution section of the Operation and Maintenance Manuals.

D. Perform additional tests required under other sections of these specifications.

E. Perform all tests in the presence of the Owner's representative.

F. The Contractor shall provide written notification to the Owner's representative and the State Electrical Inspector thirty days in advance of requests for rough-in and substantial completion inspections.

3.03 PENETRATIONS OF FIRE BARRIERS

A. Related information to this section appears in Division 07, Fire Stopping.

B. All holes or voids created to extend electrical systems through fire rated floors, walls or ceiling shall be sealed with an asbestos-free intumescent fire stopping material capable of expanding 8 to 10 times when exposed to temperatures 250ºF or higher.

C. Materials shall be suitable for the fire stopping of penetrations made by steel, glass, plastic and shall be capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E814 and UL 1479.

D. The rating of the fire stops shall be the same as the time-rated floor, wall or ceiling assembly.

E. Install fire stopping materials in accordance with the manufacturer's instructions.

F. Unless protected from possible loading or traffic, install fire stopping materials in floors having void openings of four (4) inches or more to support the same floor load requirements as the surrounding floor.

END OF SECTION

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SECTION 26 05 05 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical Demolition.

1.02 RELATED SECTIONS

A. Division 01 - Alteration Project Procedures.

B. Division 02 - Minor Demolition for Remodeling.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on a non-destructive walkthrough and existing record documents. Report discrepancies to Owner and Architect/Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, and ceilings scheduled for removal.

B. 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.

C. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

D. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service

at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Division 01, Division 02, and this Division.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Where abandoned conduit is installed below existing slab not scheduled for demolition, remove the conductors, cut conduit flush with floor, and patch surface.

F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

G. Disconnect and remove abandoned panelboards and distribution equipment.

H. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

I. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

J. Repair adjacent construction and finishes damaged during demolition and extension work. T-bar ceiling tiles damaged under normal construction conditions or having voids where junction boxes were removed shall be replaced by the Contractor.

K. Maintain access to existing electrical installations which remain active.

L. Extend existing installations using materials and methods as specified.

M. Where materials or equipment are to be turned over to Owner or reused and installed by the Contractor, it shall be the Contractor’s responsibility to maintain condition of materials and equipment equal to the existing condition of the equipment before the work began. Repair or replace damaged materials or equipment at no additional cost to the Owner.

N. Relocate existing lighting fixtures as indicated on Drawings. Test fixture to see if it is in good working condition before installation at new location.

O. Contractor to field verify conduits and electrical items in walls to be demolished prior to start of work. Demolish conduits, boxes, devices, equipment, etc. In walls that are scheduled for demolition. Where conduits pass through the walls or circuits are shared with equipment that is existing to remain, provide all work necessary (including extending and re-routing conduits) to maintain access and provide electrical continuity to existing systems and circuitry.

3.04 EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse.

B. Tag unused circuits as spare.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated directories where more than three circuits have been modified or rewired.

3.05 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces, rinse with clean water and wipe dry. Replace lamps, ballasts, drivers and broken electrical parts.

3.06 INSTALLATION

A. Install relocated materials and equipment under the provisions of Division 01.

3.07 DISPOSAL

A. Dispose of all hazardous waste in accordance with all local, State and Federal requirements under the provisions of Division 02.

END OF SECTION

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SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building Wire.

B. Cable.

C. Wiring Connections and Terminations.

1.02 RELATED SECTIONS

A. Section 26 01 26 – Maintenance Testing of Electrical Systems.

B. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

A. ANSI/NEMA WC 70-2021 – Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

B. NETA ATS – Acceptance testing specifications for Electrical Power Distribution and Systems.

C. NFPA 262 – Standard Method of test for flame travel and smoke of wires and cables for use in air-handling spaces.

D. UL 83 – Thermoplastic Insulated Wire and Cable.

E. UL 1063 – Standard for Machine and Tool Wire and Cable.

F. UL 1424 – Standard for Cables for Power-Limited Fire Alarm.

G. UL 1479 – Standard for Fire Tests of Through Wall Penetration Fire Stops.

H. UL 1569 – Standard for Metal Clad Cable.

I. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.04 SUBMITTALS

A. Submit data under provisions of Division 01 and Section 26 05 00.

B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.05 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

PART 2 PRODUCTS

2.01 BUILDING WIRE

A. Thermoplastic-insulated Building Wire: NEMA WC 70.

B. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor.

C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor.

D. Insulation Type: 600 volt insulation.

1. Interior Locations: THHN/THWN or XHHW-2. THW may be used for feeders and branch circuits larger than 6AWG.
2. Exterior Locations: XHHW-2.

E. Branch Circuit Wire Color Code:

1. Color code wires by line or phase as follows:

a. Black, red and white for 120/240V systems.

b. Black, red, blue and white for 120/208V systems.

c. Brown, orange, yellow and gray for 277/480V systems.

2. For conductors 6 AWG and smaller, insulation shall be colored. For conductors 4 AWG and larger, identify with colored phase tape at all terminals, splices, and boxes.

3. Grounding conductors 6 AWG and smaller shall have green colored insulation. For 4 AWG and larger, use green tape at both ends and at all other visible points in between, including pull and junction boxes.

F. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.

G. Fire Alarm Notification Appliance Circuits: Copper, solid or stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.

2.02 METAL CLAD CABLE

A. UL 83, 1063, 1479, 1569, and 1581 listed, meets Federal Specification A-A-59544 (formerly J-C-30B). UL rated for installation in cable trays and environmental air handling spaces. Fire wall rated for 1, 2, and 3-hour through penetrations.

B. Type MC Cable, Size 12 Through 10 AWG: Solid copper conductor, 600 volt thermoplastic insulation, rated 90º C dry, 75º wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar.

C. Type MC Cable, Size 8 Through 1 AWG: Stranded copper conductor, 600 volt thermoplastic insulation, rated 90º C dry, 75º wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar.

D. Fire Alarm/Control Type MC Cable, Size 18 through 12 AWG: Complying with UL 66, 83, 1424, 1479, 1569, 1581, and NFPA 262 (formerly UL 910), solid copper conductor, 300 volt thermoplastic insulation, rated 90°C, insulated green grounding conductor, and red-striped galvanized steel armor over mylar. Conductor insulation shall be color-coded in accordance with Section 28 31 00.

E. 0-10V Dimming/Power MC Cable (Type MC-PCS), Size 12 Through 10 AWG With 16-2 Control Cables: Solid copper conductor, 600 volt thermoplastic insulation, rated 90º C dry, 75º wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar

F. All metal clad cable shall be provided with color-coded insulation on all ungrounded conductors in accordance with NEC 210.5(C) and Part 3 of this section.

2.03 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 90º C, individual conductors twisted together, shielded, and covered with an overall PVC jacket; UL listed.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90º C, individual conductors twisted together, shielded or unshielded (as required), and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90º C, individual conductors twisted together, shielded or unshielded (as required), and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.04 WIRING CONNECTIONS AND TERMINATIONS

A. For conductors 8 AWG and smaller:

1. Dry interior areas: Spring wire connectors, pre-insulated “twist-on” rated 105 degrees C per UL 468C. Where stranded conductors are terminated on screw type terminals, install crimp insulated fork or ring terminals. Thomas & Betts Sta-Kon or equal.

2. Motor connections: Spring wire connectors, pre-insulated “twist-on” rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.

3. Wet or exterior: Spring wire connectors, pre-insulated “twist-on”, resin filled rated for direct burial per UL 486D.

4. Luminaires: UL listed, 4A, 600V, luminaire disconnect with tin-plated brass contacts, finger-safe polycarbonate female housing, 105º C temperature rating, and two or three-pole configuration to match load served.

B. For conductors 6 AWG and larger:

1. Bus lugs and bolted connections: 600 V, 90 degrees C., two hole long barrel irreversible compression copper tin plated. Thomas & Betts or approved equal.

2. Motor connection: 600 V, 90 degrees C., copper tin plated compression motor pigtail connector, quick connect/disconnect, slip on insulator. Thomas & Betts or approved equal.

3. Two way connector for splices or taps: 600 V, 90 degrees C., compression long barrel, copper tin plated. Thomas & Betts or approved equal. Insulate with Scotch 23 rubber insulating base covering and Scotch 33+ outer wrap.

PART 3 EXECUTION

3.01 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 18 AWG for control wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

C. Splice only in junction or outlet boxes.

D. Neatly train and lace wiring inside boxes, equipment, and panelboards.

E. Make Conductor lengths for parallel circuits equal.

F. Wiring in lighting fixture channels shall be rated for 90º C minimum.

G. Do not share neutral conductors. Provide a dedicated neutral conductor for each new branch circuit that requires a neutral.

3.02 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Verify that raceway is complete and properly supported prior to pulling conductors. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Do not install XHHW-2 conductors when ambient temperatures are below 23F and THHN/THWN conductors when ambient temperatures are below 32F.

D. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.

E. Place an equal number of conductors for each phase of a circuit in same raceway or cable.

F. Route conductors from each system in independent raceway system and not intermix in the same raceway, enclosure, junction box, wireway, or gutter as another system unless otherwise shown on the plans.

G. No more than six current carrying conductors shall be installed in any homerun unless otherwise indicated on the drawings or without prior approval from the Engineer.

H. Completely and thoroughly swab raceway system before installing conductors.

I. When two or more neutrals are installed in one conduit, identify each with the proper circuit number in accordance with Section 26 05 53.

3.03 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage.

B. Support cables above accessible ceilings; do not rest on ceiling tiles. Use spring metal clips or cable ties to support cables from structure. Do not support cables from ceiling suspension system. Include bridle rings or drive rings.

C. Use suitable cable fittings and connectors.

3.04 WIRING CONNECTIONS AND TERMINATIONS

A. Stranded wire shall not be wrapped around screw terminals.

B. Splice only in accessible junction boxes.

C. Thoroughly clean wires before installing lugs and connectors.

D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

E. Terminate spare conductors with twist on connectors or heat shrink insulation to proper voltage rating.

F. Control systems wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.

G. Code sound and signal systems wiring and any special equipment in accordance with manufacturer's diagrams or recommendations.

H. Do not exceed manufacturer's recommended pull tensions.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01 and Section 26 01 26.

B. Inspect wire and cable for physical damage and proper connection.

C. Torque conductor connections and terminations to manufacturer's recommended values.

3.06 WIRE AND CABLE INSTALLATION SCHEDULE

A. All Locations: Building wire and/or remote control and signal cable in raceways.

B. At the Contractor’s option, Metal Clad cable may be used for branch circuit wiring in dry locations other than homeruns. Homeruns shall be building wire in raceway. Metal Clad cable used for branch circuit wiring from a light switch to the light fixture shall include a neutral conductor.

C. At the Contractor’s option, portions of the fire alarm wiring in dry, concealed locations may be installed in Fire Alarm Metal Clad cable.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power System Grounding.

B. Communication System Grounding.

C. Electronic Safety and Security System Grounding.

D. Electrical Equipment and Raceway Grounding and Bonding.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Section 26 05 00 – Common Work Results for Electrical, Division 27 and Division 28.

B. Section 26 01 26 – Maintenance Testing of Electrical Systems.

C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

D. Section 41 36 19 – Joining Equipment: Welding, Structural.

1.03 REFERENCE STANDARDS

A. ANSI/NEMA GR-1, Ground Rod Electrodes and Ground Rod Electrode Couplings.

B. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.

C. AWS A5.8/A5.8M – Specification for Filler Metals for Brazing and Braze Welding.

D. IEEE Std 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

E. IEEE Std 142 – Recommended Practice for Grounding of Industrial and Commercial Power System.

F. UL 467 – Standard for Grounding and Bonding Equipment.

1.04 SYSTEM DESCRIPTION

A. Provide an extension to the existing facilities complete grounding system for equipment as required by State and Local Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

1.05 SUBMITTALS

A. None required for this section.

1.06 COORDINATION

A. Division 01 – Administrative Requirements: Requirements for Coordination.

B. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bonding Conductors: Solid bare copper wire for sizes No. 8 AWG and smaller diameter. Stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors may be insulated conductors if used provide green insulation.

B. Grounding Conductors: Copper conductor bare or green insulated.

C. Mechanical Grounding and Bonding Connectors: Non-reversible crimp type lugs only. Use factory made compression lug for all terminations.

D. In external locations, clamping shall be used only where a disconnect type of connection is required. Connection device may utilize threaded fasteners and shall be constructed such that positive contact pressure shall be maintained at all times. Machine bolts with lock washers shall be used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide a separate, insulated equipment-grounding conductor in all new feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.

B. Bond together system neutrals, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing and fuel systems.

C. Grounding conductors for branch circuits shall be sized in accordance with NEC, except minimum size grounding conductor shall be No. 12 AWG.

D. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.

3.02 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Continuity Test: Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

END OF SECTION

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section included hangers and supports for Power Systems, Communication Systems and Electronic Safety and Security Systems.

B. Conduit Supports.

C. Formed Steel Channel.

D. Sleeves.

E. Equipment Bases and Supports.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical, Division 27 and Division 28.

1.03 REFERENCES

A. International Building Code (IBC), Chapter 16 – Structural Design.

1.04 SUBMITTALS

A. Division 01: Requirements for submittals.

B. Product Data: Submit product data for specialty supports.

1.05 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 PRODUCTS

2.01 CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.

2. Minerallac Fastening Systems.

3. O-Z Gedney Co.

4. Substitutions: per Division 01

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. self-locking.

2.02 FORMED STEEL CHANNEL

A. Manufacturers:

1. B-Line Systems.

2. Allied Tube & Conduit Corp.

3. Unistrut Corp.

4. Substitutions: per Division 01.

B. Product Description:

1. Dry Interior: Pre-galvanized 12 gauge thick channel.
2. Exterior or Wet Interior Locations: Hot dipped galvanized steel 12 gauge thick channel.
3. Size/configuration: 1-5/8” x 1-5/8” with holes 1-1/2 inches on center.

2.03 SLEEVES

A. Sleeves Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Fire-stopping Insulation: Glass fiber type, non-combustible.

E. Mechanical Sleeve Seal: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts

and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

3.02 PREPARATION

A. Obtain permission from Owner’s Representative before using powder-actuated anchors.

B. Obtain permission from Owner’s Representative before drilling or cutting structural members.

3.03 INSTALLATION - GENERAL

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, beam clamps, or spring steel clips.

B. Use toggle bolts or hollow wall fasteners in hollow masonry partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

C. Do not support raceways, low voltage pathways, cables, or boxes from ceiling suspension wires or suspended ceiling systems. Provide support from building structure independently to allow ceiling removal and replacement without removal of electrical system. If dedicated support wires are used, wires and wire clips must be painted or color-coded. Exception: Outlet boxes for ceiling-mounted light fixtures and smoke detectors may be mounted in the ceiling system.

D. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling suspension system.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. Install surface-mounted cabinets with minimum of four anchors.

G. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

H. Securely fasten fixtures and equipment to building structure in accordance with manufacturer's recommendations and to provide necessary earthquake anchorage.

I. Provide wall attached fixtures and equipment weighing less than 50 pounds with backing plates of at least 1/8" x 10" sheet steel or 2" x 10" fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.

J. Earthquake Anchorages:

1. Equipment weighing more than 50 pounds shall be adequately anchored to the building structure to resist lateral earthquake forces.

2. Total lateral (earthquake) forces shall be 1.5 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.

K. Provide one seismic support wire for all fixtures weighing less than 10lbs. two minimum color-coded dedicated seismic support wires for each ceiling mounted light fixture weighing less than 50 pounds. Attach support wires to building structure independent from ceiling system and on opposing corners of the light fixtures to not allow fixture to drop more than 6 inches upon ceiling failure. Secure each end with three tight wraps within 1 inch at each end of the wire. Provide four supports on fixtures >50 lbs.

L. Power-driven fasteners are prohibited for tension load applications (such as supporting luminaries or conduit racks from ceiling above). Use drilled-in expansion anchors, or drilled and screw-in anchors such as Kwik-Con II or Tapcon.

3.04 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing insulation and caulk. Utilize fire stopping insulation where conduit or raceway penetrates a fire rated surface. Provide airtight caulking where conduit or raceway penetrates from dry to wet or warm to cold environments. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install escutcheons at finished surfaces. Utilize chrome plated steel for dry interior locations. Use stainless steel for all other locations.

END OF SECTION

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit.

B. Boxes.

C. Wireway

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Division 26, Division 27 and Division 28.

B. Division 07 Thermal and Moisture Protection.

C. Division 08 Openings: Access Doors and Frames.

D. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

E. Section 26 05 26 – Grounding and Bonding for Electrical Systems.

F. Section 26 05 29 – Hangers and Supports for Electrical Systems.

G. Section 26 05 53 – Identification for Electrical Systems.

H. Section 26 27 26 – Wiring Devices.

1.03 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

B. American Society for Testing and Materials (ASTM):

1. ASTM A 123 – Specification for Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.

C. National Electrical Manufacturers Association (NEMA):

1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

2. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

3. NEMA TC 7 - Smooth-Wall Coilable Polyethylene Electrical Plastic Conduit.

4. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.04 RACEWAY AND BOX INSTALLATION SCHEDULE

A. In or through CMU walls:

1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may penetrate through CMU walls where the EMT is installed in a sleeve and does not come in direct contact with the CMU. All conduit in contact with concrete or block shall be rigid steel conduit half lapped wrapped with pipe wrap or be plastic-coated conduit.

2. Boxes and Enclosures: Provide concrete tight cast and listed sheet metal boxes.

B. Outdoor Above Grade, Damp or Wet Interior Locations:

1. Raceway: Provide rigid steel conduit or intermediate metal conduit.

2. Boxes and Enclosures: Provide weatherproof malleable iron for branch circuit junction and outlet boxes. Provide weatherproof NEMA 3R sheet metal enclosures for safety and disconnect switches and NEMA 4 sheet metal enclosures with gaskets for motor controllers and control panels.

3. Fittings: Provide galvanized malleable iron with gaskets. Provide Myers threaded hubs for all conduit entries into top and side of sheet metal enclosures.

C. Concealed Dry Locations:

1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.

2. Fittings: Provide galvanized malleable iron and steel.

D. Exposed Dry Locations:

1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing. EMT conduit shall not be used where subject to physical damage or where indicated below:

2. Boxes and Enclosures: Provide sheet-metal boxes with raised steel covers.

3. Fittings: Provide galvanized malleable iron and steel.

4. Surface Raceway and Boxes: Where specifically noted on the Drawings, provide surface raceway and boxes.

E. Branch Circuits and Feeders 100 Amperes or Larger:

1. Raceway: Provide rigid steel conduit or intermediate metal conduit.

2. Boxes and Enclosures: Provide sheet-metal boxes.

3. Fittings: Provide galvanized malleable iron and steel.

F. Equipment Connections: Provide short extensions (three feet maximum) of flexible metal conduit for connections to light fixtures, motors, transformers, vibrating equipment or equipment that requires removal for maintenance or replacement. Use Liquidtight flexible conduit and fittings for motors and equipment in damp or wet locations or subject to spilling of liquids as at pumps, kitchen equipment, in mechanical rooms, boiler rooms, pump rooms, etc.

G. Liquidtight flexible nonmetallic conduit and electrical nonmetallic tubing are not approved raceway systems for this project.

1.05 DESIGN REQUIREMENTS

A. Raceway Minimum Size:

1. Below Grade: Provide 1 inch minimum, unless otherwise noted.

2. Above Grade or Within Slab: Provide 1/2 inch minimum, unless otherwise noted.

3. Line Voltage Circuits: Raceway is sized on the drawings for copper conductors with 600-Volt type XHHW insulation, unless otherwise noted. Where a raceway size is not shown on the drawings, it shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9 using the conduit dimensions of the NEC Table 4, Chapter 9 and conductor properties of the NEC Table 5, Chapter 9.

4. Fire Alarm and other Low-Voltage Circuits: Raceway size shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9, using the conduit dimensions of the NEC Table 4, Chapter 9, and cable diameter provided by the manufacturer.

B. Box Minimum Size: Provide all boxes sized and configured per NEC Article 370 and as specified in this section.

1.06 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Product Data: Submit data for products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Rigid Steel Conduit: ANSI C80.1, UL 6.

B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; Galvanized malleable iron with threaded hubs for all conduit entries. Provide threaded connections and couplings only. Set Screw and running thread fittings are not permitted.

C. Provide insulated throat bushings at all conduit terminations.

2.02 INTERMEDIATE METAL CONDUIT (IMC)

A. Product Description: ANSI C80.6, UL 1242; Galvanized Steel Conduit.

B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; use fittings and conduit bodies specified above for rigid steel conduit.

C. Provide insulated throat bushings at all conduit terminations.

2.03 FLEXIBLE METAL CONDUIT (FMC)

A. Product Description: UL 1, FS WW-C-566; galvanized or zinc-coated flexible steel, full-wall or reduced wall thickness.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron with insulated throat bushings. Die cast zinc or threaded inside throat fittings are not acceptable.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Product Description: UL 360, flexible metal conduit with interlocked steel construction and PVC jacket.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; liquid tight steel or malleable iron with insulated throat bushings. Die cast fittings are not acceptable.

2.05 ELECTRICAL METALLIC TUBING (EMT)

A. Product Description: ANSI C80.3, UL 797; galvanized steel tubing.

B. Fire Alarm EMT: Provide EMT with factory or field-applied red topcoating.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression or set screw type with insulated throat bushings. Zinc die cast or indentor fittings are not acceptable.

D. Provide factory elbows on sizes 1-½" and larger.

2.06 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, UL514A galvanized steel, with plaster ring where applicable.

1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.

2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required. Minimum Size: 4 inches square or octagonal, 2-1/8 inches deep.

3. Cut-In Boxes: Minimum size 2” x 3” x 2-1/2” deep. Provide cut-in outlet boxes where required for installation in existing walls

B. Cast Boxes: NEMA FB 1, Type FD, galvanized malleable iron or copper-free cast aluminum. Furnish gasketed cover by box manufacturer. Furnish threaded hubs. “Bell” boxes are not allowed.

C. Wall Plates: As specified in Section 26 27 26 – Wiring Devices.

2.07 PULL AND JUNCTION BOXES

A. Sheet Metal Pull and Junction Boxes: ANSI/NEMA OS 1, UL514A galvanized steel.

1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.

B. Sheet Metal Boxes Larger Than 12 Inches in Any Dimension: Hoffman or approved equal.

C. Boxes for Outdoor and Wet Location Installations: NEMA 250, Type 3R; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.

2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover and screws.

2.08 EXPANSION FITTINGS

A. Galvanized malleable iron, galvanized with grounding bond jumper.

2.09 BUSHINGS

A. Non-grounding: Threaded impact resistant plastic.

B. Grounding: Insulated galvanized malleable iron/steel with hardened screw bond to raceway and conductor lug.

2.10 LOCKNUTS

A. Threaded Electro Zinc Plated Steel designed to cut through protective coatings for ground continuity.

2.11 WIREWAY

A. Product Description: General purpose type wireway.

B. Size per NEC minimum fill capacity unless otherwise indicated on Drawings.

C. Knockouts: Field-installed, no factory knockouts acceptable.

D. Cover: Screw cover. Provide raintight where installed outdoors.

E. Fittings and Accessories: Include factory couplings, offsets, elbows, adapters and support straps required for a complete system. Provide internal ground bonding jumper bonded to each section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Provide support and fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Unless otherwise noted, do not inter-mix conductors from separate panelboards or any other system in the same raceway system or junction boxes.

3.02 INSTALLATION - GENERAL RACEWAY

A. Install raceway for all systems, unless otherwise noted.

B. Install an equipment grounding conductor inside of all raceways containing line voltage conductors.

C. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motor and equipment connections and in Mechanical and Electrical Equipment rooms. Do not route conduits on roofs, outside of exterior walls, or along the surface of interior finished walls unless specifically noted on the plans.

D. Raceway routing and boxes are shown in approximate locations unless dimensioned. Where raceway routing is not denoted, field-coordinate to provide complete wiring system.

E. Do not route raceways on floor. Where surface raceways are allowed in equipment rooms, arrange raceway and boxes to maintain a minimum of 6 feet 6 inches of headroom and present a neat appearance. Install raceways level and square. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls, ceiling, and adjacent piping.

F. Maintain minimum 6-inch clearance between raceway and mechanical and piping and ductwork. Maintain 12-inch clearance between raceway and heat sources such as flues, steam pipes, heating pipes, heating appliances, and other surfaces with temperatures exceeding 104 degrees F.

G. Do not install raceway embedded in spray applied fire proofing.

H. Route raceway through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate all requirements with Division 07 of these specifications.

I. Where raceway penetrates fire-rated walls and floors, seal raceway penetrations of fire-rated walls, ceilings, floors in accordance with the requirements of Section 26 05 00 and Division 07.

J. Raceways and boxes penetrating vapor barriers or penetrating areas from cold to warm shall be taped and sealed with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall include a vapor barrier on the outside.

K. Conduit embedded in concrete or solid masonry shall not be larger than 1/3 the thickness of the wall or slab and shall be spaced not less than three diameters apart. No cutting of reinforcing bars shall be permitted unless specifically approved. Should structural members prevent the installation of conduit or equipment, notify the Owner or Contracting Officer before proceeding.

L. Route conduits in slabs to have 1 inch minimum cover. Conduits in slab shall not compromise the structural integrity of the slab.

M. Arrange raceway supports to prevent misalignment during wiring installation.

N. Do not attach raceway to ceiling support wires or other piping systems and do not fasten raceway with wire or perforated pipe straps. Remove all wire used for temporary raceway support during construction, before conductors are pulled. Raceway shall be installed to permit ready removal of equipment, piping, ductwork, or ceiling tiles.

O. Group raceway in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps, as specified in Section 26 05 29. Provide space on each rack for 25 percent additional raceway.

P. Cut conduit square; de-burr cut ends. Bring conduit to the shoulder of fittings and couplings and fasten securely.

Q. Use threaded raintight conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Sealing locknuts are not acceptable.

R. Install no more than 360-degrees of bends between boxes.

S. Install conduit bodies to make sharp changes in direction, such as around beams. “Goosenecks” in conduits are not acceptable.

T. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.

U. Provide protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.

V. Avoid moisture traps; install junction box with drain fitting at low points in raceway system.

W. Install fittings and flexible metal conduit to accommodate 3-axis movements where raceway crosses seismic joints.

X. Install fittings designed and listed to accommodate expansion and contraction where raceway crosses control and expansion joints.

Y. Provide weatherhead or threaded cap on all raceway stub ups which are outdoors and do not terminate into equipment.

Z. Use cable sealing fittings forming a watertight non-slip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor outside diameter. Use Appleton CG series or equal cable sealing fittings.

AA. Use suitable caps to protect installed raceway against entrance of dirt and moisture.

BB. Paint all exposed conduit in finished spaces to match surface to which it is attached or crosses. Clean greasy or dirty conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors or walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.03 REUSE OF EXISTING CONDUITS

A. Where shown on Drawings that existing conduits may be used, that is only applicable if the existing conduit meets the following minimum criteria:

1. Conduit is sized per minimum NEC requirements.
2. Conduit is properly supported as required in the Contract Documents.
3. Conduit is in good, useable condition and is not deformed, damaged or showing signs of corrosion.
4. Conduit is of the type specified and allowable in the Contract Documents.

3.04 INSTALLATION – GENERAL BOXES

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.

B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel. Coordinate locations and sizes of required access doors with Division 08.

C. Coordinate layout and installation of boxes to provide adequate headroom and working clearance and to present a neat appearance. Coordinate mounting heights and locations of outlets.

D. Unless otherwise dimensioned on Plans, align wall-mounted outlet boxes for switches, thermostats, and similar devices.

E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems and where normal and emergency power circuits occur in the same box.

F. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.

G. Unless otherwise specifically noted, locate outlet boxes for light switches within 6 inches of the door jamb on the latch side of the door.

H. Position outlets to locate luminaires as shown on reflected ceiling plans.

I. Provide knockout closures for unused openings.

J. Install boxes in walls without reducing effectiveness of wall insulation or vapor barrier.

K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness.

L. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes. Accurately position bridges to allow for surface finish thickness.

M. Do not install flush mounted boxes back-to-back in walls; install with minimum 6 inches separation.

N. Install with minimum 24 inches separation in fire rated walls. Limit penetrations in fire rated walls to 16 square inches each and a maximum total combined penetration area of 100 square inches in any given 100 square feet of wall. Where penetrations are in excess of these requirements, provide UL listed fire stop wrap acceptable to Authority having Jurisdiction.

O. Do not fasten boxes to ceiling support wires or other piping systems.

P. Support boxes independently of conduit.

Q. Clean interior of boxes to remove dust, debris, and other material and clean exposed surfaces and restore finish.

R. Provide blank covers or plates for all boxes that do not contain devices.

S. Paint all exposed boxes in finished spaces to match surface to which it is attached to. Clean greasy or dirty boxes prior to painting in accordance with paint manufacturer's instructions.

3.05 INSTALLATION – WIREWAY

A. Bolt wireway to steel channels fastened to the wall or ceiling or in self-supporting structure. Install level.

B. Mount wireway per manufacturer’s installation instructions.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates

B. Tape Labels.

C. Wire and Cable Markers.

D. Fire Alarm Conduit and Box Identification.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

D. Section 26 24 16 – Panelboards.

E. Section 26 27 26 – Wiring Devices.

F. Section 28 46 00 – Fire Detection and Alarm.

1.03 SUBMITTALS

A. Division 01 and Section 26 05 00 – Common Work Results for Electrical.

B. Product Data:

1. Submit manufacturer’s catalog literature for each product required.

2. Submit electrical identification schedule including list of wording, symbols, letter size, color-coding, tag number, location, and function.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved white letters on black background. Nameplate for service disconnect shall be engraved white letters on red background.

B. Letter Size:

1. 1/4-inch high letters for identifying individual panel or equipment.

2. 1/8-inch high letters for remaining lines with 1/8 inch spacing between lines.

C. Minimum nameplate size: 1/8 inch thick with a consistent length and height for each type of nameplate wherever installed on the project.

2.02 TAPE LABELS

A. Product Description: Adhesive tape labels, with 3/16 inch Bold Black letters on clear background made using Dymo Rhino series label printer or approved equal.

B. Embossed adhesive tape will not be permitted for any application.

2.03 WIRE AND CABLE MARKERS

A. Power and Lighting Description: Machine printed heat-shrink tubing, cloth or wrap-on type, for all neutrals and Phase conductors.

B. Low Voltage System Description: Self-adhesive machine printed label with unique wire number that is shown on shop drawing for system.

2.04 FIRE ALARM CONDUIT AND BOX IDENTIFICATION

A. Product Description: Red spray paint for fire alarm boxes.

B. Fire alarm conduit shall have red finish, as specified in Section 26 05 33.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Degrease and clean surfaces to receive nameplates and tape labels.

B. Install nameplates and tape labels parallel to equipment lines.

3.02 NAMEPLATE INSTALLATION

A. Secure nameplates to equipment fronts using machine screws tapped and threaded into panelboard, or using rivets. The use of adhesives is not acceptable. Machine screws to not protrude more than 1/16 inch on back side.

B. Service Disconnect Nameplate: Provide nameplate on exterior service disconnect that reads “SERVICE DISCONNECT”.

C. Distribution Panel Nameplates:

1. Provide circuit breaker identification for each feeder breaker.

a. Line 1: Name of panelboard or equipment served.

b. Line 2: Location of served panelboard.

D. Disconnects, Starters, or Contactors:

1. Provide nameplate for each device with the following information:

a. Line 1: Load served.

b. Line 2: Panelboard and circuit number from which the device is fed.

c. Line 3: Fuse or Circuit amperage and poles. Where fused disconnect is installed, denote the maximum fuse size to be installed.

E. Control or Low Voltage System Panels:

1. Provide nameplate for each control panel with the following information:

a. Line 1: Unique panel name as shown on the shop drawings.

b. Line 2: System description such as Fire Alarm, etc.

c. Line 3: Panelboard and circuit number from which the panel is fed if applicable.

3.03 LABEL INSTALLATION

A. Spare Raceways: Provide raceway label on each individual raceway denoting the source and termination point at each end.

B. Fire Alarm Device Labels: As specified in Section 28 46 00.

C. Low-Voltage System Device Labels: Provide label on each device, denoting device ID or address where applicable. Affix label to device faceplate for ceiling-mounted devices or wall-mounted devices above 8’-0” AFF. Affix label inside backbox for exterior devices.

3.04 WIRE IDENTIFICATION

A. Provide wire markers on each new conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identification shall be as follows:

1. Markers shall be located within one inch of each cable end, except at panelboards, where markers for branch circuit conductors shall be visible without removing panel deadfront.

2. Each wire and cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.

3. Color code phases, neutral, and ground per NEC requirements and Section 26 05 19.

4. Color-code all low-voltage system wires and cables in accordance with the individual sections in which they are specified.

5. For power and lighting circuits, identify with branch circuit or feeder number.

6. Control Circuits: Control wire number as indicated on schematic and shop drawings.

7. Fire Alarm Circuits: Provide cable markers showing NAC or SLC loop identification number at all fire alarm junction boxes and pullboxes.

B. Provide pull string markers at each end of all pull strings. Marker shall identify the location of the opposite end of the pull string.

3.05 JUNCTION BOX IDENTIFICATION

A. Fire Alarm: In accessible ceiling spaces, exposed ceiling spaces, and other non-public spaces, paint fire alarm junction boxes and pullboxes with red spray paint. In all finished spaces where fire alarm boxes are visible, they shall be painted to match the surrounding finish. If there are any questions as to whether fire alarm boxes shall be painted red in a specific area, the Contractor shall get clarification from the Owner prior to painting.

B. Label each lighting and power junction box with the panelboard name and circuit number.

C. For junction boxes above ceilings, mark the box cover with the circuit or system designation using permanent black marker. For junction boxes in finished areas, mark the inside of the cover with the circuit or system designation using permanent black marker.

3.06 DEVICE PLATE IDENTIFICATION

A. Label each new receptacle and light switch device plate or point of connection denoting the panelboard name and circuit number.

B. Install adhesive label on the top of each plate.

3.07 PANELBOARD IDENTIFICATION

A. Provide updated panelboard circuit directories in accordance with Section 26 24 16.

3.08 LOW-VOLTAGE SYSTEM IDENTIFICATION

A. Install all labeling in accordance with the requirements of this section and of each section where the individual systems are specified.

END OF SECTION

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SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

A. Section includes Cx process requirements for the following electrical components, systems, assemblies, and equipment in areas modified by this project:

1. Electrical equipment connected to Normal power systems, including the following:
    a. Transformers.
    b. Generator
    c. Grounding systems.
2. Electrical equipment connected to Essential power systems that provide an alternative source of power in the absence of power from the Normal power system, including the following:
    a. Distribution and branch-circuit panelboards.
    b. Grounding systems.
    c. Generators.
    d. UPS.
3. Controls and instrumentation, including the following:
    a. Equipment monitoring systems.
    b. Energy monitoring and control systems.
    c. Electrical metering and metering system.
    d. Demand response systems.
    e. Lighting control systems.
4. Systems testing and verification, including Normal and Essential power systems, and transitions from Normal to Essential power systems and back.

B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.

1.03 DEFINITIONS

A. BoD: Basis-of-Design Document, as defined in Section 019113 "General Commissioning Requirements."

B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."

C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."

D. Essential Power Systems: A power system that a facility transitions to in the absence of Normal power. This power includes all systems classified as "standby" or "emergency," including "legally required."

E. Low Voltage: 600 V and below.

F. Medium Voltage: 601 V and above.

G. Normal Power Systems: A power system that provides primary power to a facility.

H. OPR: Owner's Project Requirements, as defined in Section 019113 "General Commissioning Requirements."

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For electrical testing technician.

B. Prefunctional Checklists: Draft prefunctional checklists will be created by CxA for Contractor review.

C. Prefunctional Checklists: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for prefunctional checklists:

1. Instrumentation and control for electrical systems.

2. Instrumentation and control for lighting control systems.

3. Metering devices.

4. Ground-fault protection systems.

5. Panelboards.

6. Automatic transfer switches.

7. Variable-frequency drives.

8. AC synchronous motors and generators.

9. Lighting.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electrical systems and components to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Testing Technician Qualifications: Technicians to perform electrical Prefunctional Checklist verification tests, Prefunctional Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:

1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in electrical systems, or similar field. Degree may be offset by three years' experience as an apprentice or a journey-level electrician. Generally, required knowledge includes electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of electrical equipment, assemblies, and systems.

B. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

   a. Equipment/instrument identification number.

   b. Planned Cx application or use.

   c. Manufacturer, make, and model.

   d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation shall meet the following criteria:

   a. Capable of testing and measuring performance within the specified acceptance criteria.

   b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.

c. Be maintained in good repair and operating condition throughout duration of use on Project.

d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

C. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

1) Instrument or tool identification number.

2) Equipment schedule designation of equipment for which the instrument or tool is required.

3) Manufacturer, make, model, and serial number.

4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.

c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREFUNCTIONAL CHECKLISTS

A. Prepare detailed prefunctional checklists for electrical systems, subsystems, equipment, and components. Complete and submit prefunctional checklists.

3.02 PREFUNCTIONAL CHECKLIST REVIEW

A. Review and provide written comments on draft prefunctional checklists. CxA will create required draft prefunctional checklists and provide them to Contractor.

B. Return draft Prefunctional Checklist review comments within 10 days of receipt.

C. When review comments have been resolved, CxA will provide final Prefunctional checklists, marked "Approved for Use, (date)."

D. Use only prefunctional checklists, marked "Approved for Use, (date)."

3.03 GENERAL TESTING REQUIREMENTS

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

F. Prefunctional Checklists: Prepare and submit detailed prefunctional checklists for electrical systems, subsystems, equipment, and components.

1. Contributors to development of prefunctional checklists shall include, but are not limited to, the following:

    a. Electrical systems and equipment installers.

    b. Electrical instrumentation and controls installers.

G. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Owner, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.

3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.

K. Comply with Prefunctional Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.

L. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests.

2. Demonstration of a sample of performance tests.

3. Cx tests.

4. Cx test demonstrations.

3.04 GENERAL ELECTRICAL SYSTEMS CX TESTS

A. Verification of Normal Power System Operation:

1. Prerequisites: Acceptance of results for prefunctional checklists for Division 26 electrical components associated with Normal power system.

2. Equipment and Systems to Be Tested: Division 26 electrical equipment.

3. Test Purpose: Verify operation of Normal power system.

4. Test Conditions: Energize components of Normal power system, one at a time.

5. Acceptance Criteria: Proper operation of Normal power system over a 24-hour period.

B. Verification of Essential Power System Operation:

1. Prerequisites:

   a. Acceptance of results for prefunctional checklists for Division 26 electrical components associated with Essential power system.

   b. Completion of "Verification of Normal Power System Operation" tests.

2. Equipment and Systems to Be Tested: Division 26 electrical equipment.

3. Test Purpose: Verify operation of Essential power system.

4. Test Conditions:

   a. Energize components of Normal power system.

   b. Simulate a failure of Normal power system.

5. Acceptance Criteria: Transfer of power from Normal to Essential power system within OPR.

C. Verification of Control and Instrumentation:

1. Prerequisites: Acceptance of results for prefunctional checklists.

   a. Section 262900 "Low Voltage Controllers."

D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential power systems.

E. Test Conditions:

1. Energize components of Normal power system.

2. Test operation of equipment.

F. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 26 08 00

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SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes stand-alone (non-networked) automatic lighting control devices.

1. Power Packs and Supplies.

2. Indoor Daylight Sensors

1.02 RELATED SECTIONS

A. Section 26 05 00 - Common Work Results for Electrical.

B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

C. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

D. Section 26 08 00 – Commissioning of Electrical Systems.

E. Section 26 50 00 – Lighting.

1.03 SUBMITTALS

A. Product Data: Submit product data for all components provided that are specified in this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

B. Fixture Compatibility: Submitted occupancy and daylight sensors shall have wattage ratings to match the circuits on which they are connected and shall be compatible with submitted lamps and ballasts/drivers in the fixtures which they will control.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include manufacturer’s installation and troubleshooting instructions.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manuals: Submit manufacturer’s instructions for daylight sensor maintenance and adjustment.

1.05 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.06 COMMISSIONING

A. Fully commission all systems, subsystems and equipment provided by this section in accordance with 26 08 00 - Electrical Commissioning.

PART 2 PRODUCTS

2.01 POWER (RELAY) PACKS AND SUPPLIES

A. Sensor Power Packs: Provide sensor power packs as recommended by the sensor manufacturer and as required for all connected devices and the specified sequence of operation. Note that control of fixtures with multi-level switching may require additional power packs. Power Packs shall be UL listed, plenum rated, and accept 120 or 277 VAC.

PART 3 EXECUTION

3.01 INSTALLATION

A. Locate power packs and similar devices in concealed, accessible areas.

3.02 LIGHTING CONTROL SEQUENCE OF OPERATIONS

1. See Plans for lighting control sequence for each space. Provide all programming, adjustment and field changes as required to perform the specified lighting control sequence.

2. Where no lighting control sequences are shown on the Plans, coordinate with the Owner to determine if the occupancy sensor default factory settings are suitable for their needs in each space and adjust accordingly.

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.04 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 24 13 - SWITCHBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes service and main distribution switchboards.

1.02 RELATED SECTIONS:

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 53 - Identification for Electrical Systems.

1.03 REFERENCES

A. American National Standards Institute:

1. ANSI C12.1 - Code for Electricity Metering.

2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.

B. Institute of Electrical and Electronics Engineers:

1. IEEE C57.13 - Standard Requirements for Instrument Transformers.

2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

C. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.

2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

3. NEMA PB 2 - Deadfront Distribution Switchboards.

4. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

D. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

E. Underwriters Laboratories Inc.:

1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

2. UL 891 - Dead-Front Switchboards.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 01 and Section 26 05 00.

B. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

1.05 CLOSEOUT SUBMITTALS

A. Submit closeout submittals under provisions of Section 26 05 00 – Common Work Results for Electrical and General Conditions in MASSB and Supplementary Conditions to the Contract.

B. Project Record Documents: Record actual locations, configurations, and ratings.

C. Operation and Maintenance Data: Submit recommended maintenance procedures and intervals.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products under provisions of Division 01.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers:

1. Same manufacturer as equipment installed in.

B. Product Description: UL 489, molded-case circuit breaker.

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 400 amperes and larger have mechanism for adjusting long time, short time, instantaneous, and ground fault (if required) current pickup setting for automatic operation.

D. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify equipment is suitable for installation.

3.02 INSTALLATION

A. Install in accordance with NEMA PB 2.1.

B. Install engraved plastic nameplates in accordance with Section 26 05 53 – Identification for Electrical Systems.

3.03 FIELD QUALITY CONTROL

A. Section 26 01 26 – Maintenance Testing of Electrical Systems.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.04 ADJUSTING

A. Adjust circuit breaker trip and time delay settings to values as recommended by the manufacturer based upon project Drawings.

END OF SECTION

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SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Service and Distribution Panelboards.

B. Branch Circuit Panelboards.

C. Load Centers.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers.

B. NEMA KS 1 - Enclosed Switches.

C. NEMA PB 1 - Panelboards.

D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

E. NEMA PB 2.2 - Application Guide for Ground-fault Protective Devices for Equipment.

F. UL 50 – Enclosures for Electrical Equipment.

G. UL 67 – Panelboards.

H. UL 98 - Enclosed and Dead-front Switches.

I. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.

J. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.

K. Federal Specification W-C-865C - Fusible Switches.

1.04 SUBMITTALS

A. Submit data under provisions of Division 01 and Section 26 05 00.

B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.05 CLOSEOUT SUBMITTALS

A. Project Record Drawings: Submit final record panel schedules as hardcopy and in Microsoft Excel format. Submit under Section 26 05 00.

B. Operation and Maintenance Manuals: Provide product data and shop drawing information including replacement parts list. Provide installation, operation and maintenance information per manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Upon arrival at the site inspect equipment and report on any damage.

C. Handle carefully on site to avoid any damage to internal components, enclosures and finishes.

D. Store in a clean, dry environment. Maintain factory packaging and provide an additional heavy canvas or plastic cover to protect enclosures from dirt, water, construction debris and traffic.

1.07 WARRANTY

A. Manufacturer shall warrant specified equipment to be free of defects for a period of one year from the date of installation.

1.08 SPARE PARTS

A. Keys: Furnish 2 each to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS - PANELBOARDS

A. Match existing panelboard type in use at the facility wherever possible.

B. Schneider/Square D.

C. Eaton.

D. General Electric.

E. Siemens.

2.02 MAIN AND DISTRIBUTION CIRCUIT BREAKER PANELBOARDS

A. Thermal Magnetic Molded Case Circuit Breakers: NEMA AB 1; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL

listed as Type HACR for air conditioning equipment branch circuits. Breaker ampacity and AIC rating shall be visible on breaker without removing panel deadfront or cover.

2.03 BRANCH CIRCUIT PANELBOARDS

A. Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

B. Enclosure: NEMA PB 1; Type 1 or 3R as indicated on Drawings. Boxes shall be galvanized steel constructed in accordance with UL50 requirements. Interiors shall be field convertible for top or bottom incoming feed. Interior leveling provisions shall be provided for flush mounted applications.

C. Cabinet Size: 6 inches deep; 20 inches wide minimum.

D. Provide flush or surface cabinet front as indicated on the Drawings with door-in-door cover concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide one continuous bus bar per phase each. Panelboards shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. Bussing shall be fully rated.

F. Integrated Short Circuit Rating: Provide panelboards with short circuit ratings as shown on the Drawings. Minimum ratings shall be 10,000 amperes RMS symmetrical for 250 volt panelboards; 14,000 amperes RMS symmetrical for 600 volt panelboards.

G. Main/Sub Feed Circuit Breakers: NEMA AB 1; Provide vertical mount main and/or sub feed circuit breaker in panelboards as shown on the drawings.

1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90^{o}C rated wire, sized according to the 75 ^{o}C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.

H. Branch Circuit Breakers: NEMA AB 1; Provide panelboards with bolt-on type thermal magnetic trip circuit breakers.

1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free with common trip handle for all poles.

2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90°C rated wire, sized according to the 75 °C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.

3. Provide circuit breakers UL listed as Type SWD for lighting circuits.

4. Provide circuit breakers UL listed as type HACR for use with heating, air conditioning and refrigeration equipment.

5. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings. Where the GFCI breaker size/configuration shown on the plans is not commercially available, an external GFCI device may be provided in lieu of a GFCI breaker for the code required ground fault protection if the location of the device is indicated on the panel schedule and a nameplate is provided at the remote GFCI device indicating the load served. North Shore Safety #PGFS series or equal.

2.04 PANELBOARD IDENTIFICATION

A. For each new panelboard and each existing panelboard where circuits are added or modified, provide typed schedule denoting each circuit load by the load type and final name and room number actually in use in the facility. Schedule shall not be typed with names shown on the Contract Drawings unless names are acceptable to the Owner.

B. Provide panel schedule in O&M manual for every new panelboard and every existing panelboard where circuits are added or modified.

C. Where more than one nominal voltage system is present on the premises, the conductor color-coding legend shall be permanently posted at each branch circuit and distribution panelboard per NEC requirements.

D. All panelboards [load centers] shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment. At a minimum the signage shall state the following:

Warning

Arc Flash and Shock Hazard

Appropriate PPE Required

E. Provide electronic copies of all panel schedules in Microsoft Excel format, submitted with the O&M manuals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1.

B. Height: 6 feet, 6 inches to top of panelboard.

C. Provide filler plates for unused spaces in panelboards.

D. Panel Schedules: Revise schedules to reflect circuiting changes required to balance phase loads.

E. Stub 5 empty one inch conduits to accessible location above ceiling [below floor] out of each recessed panelboard.

3.02 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION

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SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall Switches.

B. Receptacles.

C. Device Plates and Box Covers.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements and Section 26 05 00 – Common Work Results for Electrical.

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

D. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

A. FS W-C-596 – Federal Specification for Electrical Power Connector, Plug, Receptacle, and Cable Outlet.

B. FS W-S-896 – Federal Specification for Switches, Toggle (Toggle and Lock), Flush Mounted.

C. NEMA WD 1 - General Color Requirements for Wiring Devices.

D. ANSI/NEMA WD 6 – Wiring Devices – Dimensional Requirement.

E. UL 20 – General-Use Snap Switches.

F. UL 498 - Attachment Plugs and Receptacles.

G. UL 943 – Ground-Fault-Circuit-Interrupters.

1.04 SUBMITTALS

A. Product Data: Submit product data for all components provided that are specified in this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - WALL SWITCHES

A. Hubbell.

B. Leviton.

C. Pass & Seymour.

D. Arrow Hart

E. Substitutions: Under provisions of Division 01.

2.02 WALL SWITCHES

A. Wall Switches for Lighting Circuits: UL 20; ANSI/NEMA WD-6; and Federal Specification FS W-S-896 AC industrial grade snap switch with toggle handle, rated 20 amperes and 120-277 volts AC. Handle: White nylon.

2.03 ACCEPTABLE MANUFACTURERS - RECEPTACLES

A. Hubbell.

B. Leviton.

C. Pass & Seymour.

D. Arrow Hart

E. Substitutions: Under provisions of Division 01.

2.04 RECEPTACLES

A. Convenience and Straight-blade Receptacles: UL 498, ANSI/NEMA WD-6 and Federal Specification FS W-C-596 industrial grade receptacle.

B. Convenience Receptacle Configuration: ANSI/NEMA WD-6; Type 5-20R, white nylon face.

C. GFCI Receptacles: ANSI/NEMA WD-6; 20A, duplex convenience receptacle with integral class ‘A’ ground fault current interrupter, LED indicator lamp and integral lockout.

D. Weather-Resistant Receptacles: ANSI/NEMA WD-6; Listed to the weather-resistant supplement of UL498 and complying with the requirements of NEC 406.9.

2.05 DEVICE PLATES

A. Decorative Cover Plate: Smooth 430 or 302 stainless steel.

B. Weatherproof Cover Plate: UL listed, cast aluminum, hinged outlet cover/enclosure, with gasket between the enclosure and the mounting surface, suitable for wet locations while in use and identified as “Extra Duty” per NEC 406.9 (B)(1).

C. Exposed Work Cover Plate: ½ inch raised, square, pressed, galvanized or cadmium plated steel cover plate supporting devices independent of the outlet box.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wall switches 48 inches above floor, OFF position down.

B. Unless otherwise noted install wall switches within 6 inches of the door jamb on the strike side.

C. Install convenience receptacles 18 inches above floor, 4 inches above counters or backsplash, grounding pole on bottom.

D. Unless otherwise noted, mounting heights are for finished floor to center line of outlet.

E. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.

F. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Use midsize or jumbo plates for outlets installed in masonry walls, where required to cover up imperfections in the wall opening.

G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

H. Install devices and wall plates flush and level.

I. Ground receptacles to boxes with a grounding wire. Grounding through the yoke or screw contact is not an acceptable alternate to the ground wire.

J. Install circuit label on each receptacle and light switch in accordance with Section 26 05 53.

END OF SECTION

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SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed Switches.

B. Enclosed Double Throw Switches.

C. Enclosures.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements and Section 26 05 00 – Common Work Results for Electrical.

B. Section 01 40 00 – Quality Requirements.

C. Section 26 05 26 – Grounding and Bonding for Electrical Systems.

D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

E. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

A. ANSI/UL 98 Enclosed and Dead Front Switches.

B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

A. Product Data: Submit product data for all components provided, showing electrical characteristics, material, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

B. Shop Drawings: Submit shop drawings include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit current interrupting rating.

1.05 CLOSEOUT SUBMITTALS

A. Project Record Drawings: Accurately indicate actual location of enclosed switches.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.07 EXTRA STOCK

A. Provide extra stock under provisions of Division 01.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - ENCLOSED SWITCHES

A. Schneider/Square D.

B. Siemens.

C. Eaton.

D. General Electric.

E. Substitutions: Under provisions of Division 01.

2.02 ENCLOSED SWITCHES

A. Nonfusible Switch Assemblies: NEMA KS 1; Heavy Duty type; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

B. Enclosures: NEMA KS 1; Type 1, 3R or 4 as indicated on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed switches where indicated on Drawings, and where required for NEC required disconnect of equipment specified under other divisions, but installed under Division 26.

B. All enclosed switches shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment. At a minimum the signage shall state the following:

Warning

Arc Flash and Shock Hazard

Appropriate PPE Required

3.02 FIELD QUALITY CONTROL

A. Field inspecting, testing, adjusting and balancing.

B. Inspect and test in accordance with NETA ATS, exception Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

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SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manual Motor Starters.

B. Magnetic Motor Starters.

C. Combination Magnetic Motor Starters.

1.02 RELATED SECTIONS

A. Division 21 – Fire Suppression.

B. Division 22 – Plumbing.

C. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC).

D. Section 26 05 29 – Hangers and Supports for Electrical Systems.

E. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

B. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

D. NEMA KS 1 - Enclosed Switches.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01.

B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include recommended maintenance procedures and intervals.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - MOTOR STARTERS

A. Schneider/Square D.

B. Allen Bradley.

C. Siemens.

D. Eaton.

E. Substitutions: Under provisions of Division 01.

2.02 MANUAL MOTOR STARTERS

A. Manual Motor Starter: NEMA ICS 2; size and number of poles as required by the load served, AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, red LED pilot light, and push button operator.

B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, number of poles as required by the load served, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.

C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated 1 or 2 pole, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, red pilot light, and toggle operator.

D. Enclosure: ANSI/NEMA ICS 6; Type 1 or 3R. As indicated on the Drawings.

2.03 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Full Voltage Starting: Non-reversing type.

C. Coil Operating Voltage: 120 volts, 60 Hertz.

D. Size: NEMA ICS 2; size as required by the load served.

E. Overload Relay: NEMA ICS 2; solid state with auto reset, 3 to 1 adjustment for trip current, phase loss, and unbalance protection.

F. Enclosure: NEMA ICS 6; Type 1 or 3R as shown on the drawings.

G. Combination Motor Starters: Combine motor starters with non-fusible switch disconnect in common enclosure.

H. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts in addition to seal-in contact.

I. Indicating Lights: NEMA ICS 2; RUN: red LED light in front cover.

J. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

K. Control Power Transformers: 120 volt secondary, VA capacity as required by the load served in each motor starter.

L. Power Monitor: Include a three-phase power monitor in each magnetic starter connected to shut down the motor on loss of any phase, phase reversal, or low voltage on any phase. Power monitor shall automatically reset and restart motor when phase and voltage conditions return to normal. Provide oversize starter enclosures as required to install power monitor.

2.04 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

A. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.

B. Nonfusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's instructions.

B. Select and install heater elements in motor starters to match installed motor characteristics.

C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

D. After final connections are made, check and correct the rotation of all motors.

E. Field adjust the trip settings of all motor starter magnetic trip only circuit breakers to approximately 11 times motor full load current. Determine full load current from motor nameplate following installation.

F. Motor starting equipment shall be listed for use with the motors specified under Division 21, 22, and 23.

END OF SECTION

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SECTION 26 50 00 – LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior and Exterior Luminaires and Accessories.

B. Lamp Modules.

C. Drivers.

D. Light Poles

E. Emergency Driver Power Supplies.

1.02 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

B. Division 09 – Finishes: Painting and Ceilings.

C. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

E. Section 26 05 29 - Hangers and Supports for Electrical Systems: General Supports for Luminaires.

F. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

G. Section 26 05 53 – Identification for Electrical Systems.

H. Section 26 09 23 – Lighting Control Devices: Compatibility with Dimming Switches.

I. Section 26 27 26 – Wiring Devices.

1.03 DEFINITIONS

A. CCT: Correlated Color Temperature.

B. CRI: Color Rendering Index.

C. Driver: LED Power Supply.

D. Fixture: See "Luminaire."

E. IES: Illuminating Engineering Society of North America

F. IP: International Protection or Ingress Protection Rating.

G. Lamp Module: Replaceable LED board array/light engine including a plug-in connector.

H. LED: Light-emitting diode.

I. Lumen: Measured output of lamp and luminaire, or both.

J. Luminaire: Complete lighting unit, including lamp or lamp module, driver, reflector, and housing.

K. THD: Total Harmonic Distortion.

1.04 REFERENCE STANDARDS

A. NECA/IESNA 500 – Recommended Practice for Installation Indoor Commercial Lighting System.

B. IES TM-21-11 Projecting Long Term Lumen Maintenance of LED Light Sources.

C. IES LM-80 IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.

D. UL 924 - Emergency Lighting and Power Equipment.

1.05 SUBMITTALS

A. Product Data: Submit the following:

1. Luminaires: Include manufacturer's product data sheets and/or shop drawings including outline drawings showing support points, weights, and accessory information for each luminaire type. Clearly indicate all options being provided. Arrange data for luminaires in the order of fixture designation.

2. Prior to preparing submittals, coordinate with the reflected ceiling plan for ceiling finishes and provide all necessary kits, brackets, stems, trim, etc. to install the specified fixtures in the ceilings provided. Clearly note these configurations on the product data sheets.

B. Shop Drawings: Provide detailed shop drawings for specialty luminaires as required by the manufacturer.

C. Warranty: Provide copies of manufacturer's warranty information for each luminaire. If warranty information is the same for a group of manufacturer's luminaires, provide a letter or schedule clearly indicating what warranty applies to each fixture.

D. LED Luminaire Substitutions: Due to the constantly evolving technology, it is difficult to evaluate a true "equal" LED luminaire since the wattage, LED life, lumen output, etc. vary significantly from fixture to fixture, even for luminaires that have a similar shape and style. The luminaires shown on the Plans in the Fixture Schedule are not intended to be sole sourced but are considered a Basis of Design. If a substitution is proposed by the contractor, it will be evaluated based on the following criteria:

1. Does it have the same basic shape/style and characteristics? Note that there may be space constraints above the ceiling.

2. Does the luminaire have the same (or superior) light output and distribution? If not, would it still produce enough light to illuminate the space per minimum IES recommendations or other project specific lighting levels? Note that the Engineer may request .ies files or lighting calculations be provided by the Contractor to evaluate substitution requests.

3. Does it use the same (or less) wattage than the specified fixture? If it uses slightly more power, does it provide enough value to the Owner by adding additional light to offset the additional power used? Is that appropriate for the project compliance requirements. (LEED, ASHRAE 90.1, etc.)

4. Does it have the same nominal color temperature and CRI values? Note that for certain luminaires this may be more important where artwork or merchandise is illuminated.

5. Does it have an equal or better lamp life as calculated in accordance with IES TM-21 and LM-80?

6. Does the manufacturer offer an equal or better warranty than the specified fixture?

7. Are the LED lamps modules and LED boards field changeable? What guarantees does the manufacturer have that replacement parts will be available in the future?

1.06 CLOSEOUT SUBMITTALS

A. Project Record Drawings: Indicate actual locations and mounting heights of all lighting fixtures and accessories on the project record drawings. Update part numbers and description on the Lighting Fixture Schedule to match the actual luminaires installed. Submit under Section 26 05 00.

B. Operation and Maintenance Manuals:

1. Provide recommended luminaire cleaning and re-lamping schedule. If any luminaire lenses require special lubricants for cleaning, include this in the schedule.

2. Provide detailed bill of materials for all items purchased in this section including distributor’s contact name, phone number and pertinent information.

3. Provide luminaire manufacturer’s installation instructions.

4. Provide manufacturer’s step-by-step installation instructions showing how to replace the LED lamp modules and drivers for each luminaire.

5. Include any specific warranty information provided by the manufacturer for luminaires, LED boards and drivers.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site, store and protect in a clean, dry environment under provisions of General Conditions of the Contract.

PART 2 PRODUCTS

2.01 INTERIOR AND EXTERIOR LUMINAIRES AND ACCESSORIES

A. Luminaires: Provide UL listed luminaires as scheduled on the drawings or as approved equal.

B. Listing: Luminaires shall be listed for use in the environment in which they are installed. For example, luminaires installed in return air plenums, direct contact with insulation, or in hazardous, wet, damp, or corrosive locations shall be UL listed for such application.

C. Accessories: Provide all mounting kits, supports, interconnecting wiring, power supplies, trim kits, gaskets, etc. for a complete installation.

D. Housing:

1. Metal parts shall be free of burrs and sharp corners and edges. Form and support to prevent warping and sagging.

2. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

3. Luminaires shall be factory painted and free of discoloration. Color as scheduled.

4. Where non-IC rated luminaires are installed in insulated ceilings, provide suitable cover above fixture to keep insulation away from the fixture per the luminaire manufacturers' installation instructions.

2.02 LAMP MODULES – LED

A. All LED's shall be nominal 4000 degrees Kelvin (nominal) within a 3-step MacAdam Ellipse unless special circumstances require a different color temperature application, see Luminaire Schedule on Plans.

B. Color Rendering: Minimum CRI as scheduled on the Plans for each fixture. Under no circumstances shall the CRI be less than 70.

C. Lamp Life: Minimum lamp life shall be calculated in accordance with IES LM-80. Lamp life for each luminaire shall be equal or greater than scheduled on the Plans. Under no circumstances shall an interior luminaire have a minimum rated life (L70) less than 50,000 hours at 75 degrees F average indoor ambient temperature and an outdoor luminaire less than 75,000 hours at 40 degrees F average outdoor ambient temperature.

D. Replaceable: Unless otherwise scheduled, all LED modules shall be field replaceable with quick disconnect connections.

E. Luminaires and lamps installed outdoors shall be rated for starting and operating at a minimum of -40F.

2.03 DRIVERS - LED

A. LED Driver: Provide UL listed power supply as recommended by the LED fixture manufacturer for operation of the specified LED lamps. Power supply shall be integral to the luminaire unless otherwise noted on the Plans. Power supply shall be dual voltage (120/277V) where available or operate at the supply voltage indicated on the Plans.

B. LED Dimming Driver: UL listed 0-10V dimming driver as recommended by the LED fixture manufacturer for operation of the specified LED lamps, fully compatible with the dimming system or dimming switch controlling the fixture. Driver shall be integral to the fixture and capable of dimming the luminaire down to 1% output unless otherwise scheduled on the Plans. Power supply shall be dual voltage (120/277V) where available and operate at the supply voltage indicated on the Plans.

2.04 EMERGENCY DRIVERS

A. LED Unit: UL listed self-contained emergency LED driver with automatic transfer to battery supply on power failure, optional test switch, AC ON pilot light, fully-automatic two-rate charger, Ni-cad battery, and power supply capable of operating an LED load of up to the rated fixture wattage (as shown on the Plans) at rated current (700mA) for a minimum of 90 minutes. Bodine #BSL series or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction items that penetrate ceilings or are supported by them, including luminaire, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies. Adjust locations as required.

B. Unless otherwise noted on Plans, provide drivers integral to luminaires, pre-wired and installed at the factory, suitable for use with the selected LED lamps.

C. Support surface-mounted luminaires directly from building structure. Install level and parallel/perpendicular with ceiling or wall surfaces.

D. Rigidly align continuous rows of lighting fixtures for true in-line appearance.

E. Provide luminaire disconnecting means in the wiring compartment of each luminaire. Where the luminaire is fed from a multi-wire branch circuit, provide multi-pole disconnect to simultaneously break all supply conductors to the ballast, including the grounded conductor.

F. LED Power Supplies: Install power supplies to be readily accessible. Where power supplies are installed in plenum areas, provide plenum rated listing. Where remote power supplies are used, install in concealed, accessible locations or in utility room that provides adequate sound

dampening. Locate driver to allow free air movement in accordance with manufacturer's installation instructions and securely mount to structure.

G. Tandem wiring: Provide factory harness for all tandem mounted light fixtures.

H. Support exterior surface-mounted luminaires directly from building structure. Maintain wall waterproofing.

I. Install emergency driver {or single fixture emergency transfer device} in the driver channel of the fixtures indicated on the drawings. Provide an unswitched source of power to the emergency driver from the same circuit that powers the fixture the driver is installed in.

J. Wiring installed between a luminaire and an emergency lighting inverter or remote emergency driver is considered "emergency" wiring and shall be separated from the normal wiring and installed in a dedicated raceway per NEC Article 700.

3.02 RELAMPING

A. Re-lamp or replace luminaires that have failed lamps at completion of work.

3.03 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Touch up luminaire finish at completion of work.

3.04 FIELD QUALITY CONTROL

A. Tests: Perform tests listed below according to manufacturer's written instructions. Test unit functions, operations, and protective features. Adjust to ensure operation complies with Specifications. Perform tests required by NFPA 70, Articles 700 and 701. Perform tests on completion of unit installation and after building circuits have been energized. Provide instruments to permit accurate observation of tests. Include the following tests:

1. Simulate power outage: Verify proper operation of each individual emergency power supply.

2. Verify emergency supply duration.

3. Verify operation of remote test switches.

4. Provide reports for load test conducted on individual batteries.

B. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.05 ADJUSTING

A. Aim lamps on wall-mounted emergency lighting units to obtain the following illumination of egress pathway:

1. An average of 1 foot-candle.

2. A minimum at any point of 0.1 foot-candle measured along the path of egress at floor level.

3. Maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.

B. Test emergency lighting equipment in accordance with the manufacturer's instructions and NECA/IESNA 500.

3.06 DEMONSTRATION

A. Walk owner's representative through the emergency lighting system. Note how to maintain, test and troubleshoot all units. Provide maintenance schedule for NFPA required testing and note locations of remote test switches, and which units have self-diagnostic features.

END OF SECTION

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SECTION 28 46 00 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Contractor designed and installed extension to the existing addressable fire alarm and smoke detection system. This is a performance type specification describing the minimum acceptable fire alarm system. The Contractor shall design and install the extension to the existing fire alarm and smoke detection system in accordance with the requirements of NFPA 72 and ICC/ANSI A117.1. The fire alarm devices on the drawings are shown in suggested locations. The final locations of all devices shall be solely determined by the Contractor and shall be in accordance with NFPA 72 and ICC/ANSI A117.1.

1.02 RELATED SECTIONS

A. Division 21 - Sprinkler System.

B. Division 25 – Mechanical: Fire/Smoke Dampers.

C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

D. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

E. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

A. NFPA 72 - National Fire Alarm Code.

B. NFPA 101 - Life Safety Code.

C. International Mechanical Code (IMC).

D. Americans with Disabilities Act (ADA) and ADA Guidelines for Buildings and Facilities (ICC/ANSI A117.1).

E. ANSI S3.41 - Audible Emergency Evacuation Signals.

F. ANSI/ASME A17.1 - Safety Code for Elevators and Escalators.

1.04 REGULATORY REQUIREMENTS

A. System: UL and FM listed.

B. Conform to the requirements of UL 864.

C. Conform to requirements of NFPA 101.

D. Conform to requirements of ICC/ANSI A117.1.

E. Install system in accordance with NFPA 72.

F. Comply with requirements of ANSI A17.1.

1.05 SYSTEM DESCRIPTION

A. Fire Alarm System: Contractor designed and installed, extension to the existing manual and automatic fire alarm system with individually addressable initiating devices. The Contractor shall design and install the fire alarm and smoke detection system in accordance with the requirements of these specifications, NFPA 72, NFPA 101, ANSI A17.1, and ICC/ANSI A117.1. The fire alarm devices on the drawings are shown in suggested locations. The Contractor shall modify these device locations as necessary to accommodate actual architectural, structural, or mechanical conditions, at no cost to the Owner.

B. Alarm Sequence of Operation: Actuation of manual fire alarm station or automatic initiating device causes system to enter ALARM, which includes the following operations:

1. Sound and display local fire alarm notification appliances with ANSI S3.41 compliant temporal signal and synchronized flash.

2. Transmit alarm signal to activate the existing digital alarm communicator.

3. Indicate location and address of device in alarm on fire alarm control panel and on remote annunciator panel if it exists.

4. Record the time, date and location of the alarm in the fire alarm panels' accessible history database.

5. Transmit signal for closure of all fire/smoke dampers and shutdown of all building supply and return air fans.

6. Transmit signal to shut down power to elevator in accordance with Rule 102.2 of ANSI/ASME A17.1. Upon activation of the heat detector used for elevator power shutdown, the system shall delay activation of the power shunt trip. Per section A.6.15.4.4 of NFPA 72, the delay shall be the time that it takes the elevator cab to travel from the top of the hoistway to the lowest recall level.

C. Addressable control relays connected to the system shall be continuously monitored for proper state and position of contacts. Incorrect positions shall be automatically corrected by command from the control panel. If control relay fails to respond to the corrective command; the trouble signal shall sound, and the panel shall identify and permanently record the location of the fault. The control panel shall also monitor addressable control relays for proper state (position) after the system has commanded the relay to operate. Failure of the control relay to operate (change state) shall cause the panel to generate a trouble signal, identify and permanently record the location of the fault.

1.06 QUALIFICATIONS

A. The installation of the system shall conform to the State of Alaska requirements and be supervised by a representative with a current State Fire Alarm License.

B. Manufacturer: Company specializing in addressable smoke detection and fire alarm systems with five years documented experience.

C. System Supplier: Factory trained to provide the submitted fire alarm system.

D. Installer: Installation of the system shall be 100% field checked by a factory trained and authorized NICET Level III technician certified in the Fire Alarm System Program. The actual supervising technician must be approved prior to start of work.

1.07 SUBMITTALS

A. Submit product data and shop drawings under the provisions of Division 01.

B. Submit shop drawings prepared and signed by a NICET Level III technician certified in fire alarm systems under the provisions of Division 01. Shop drawings shall have the following requirements:

1. The Shop Drawings shall be reproduced electronically from a Master Copy supplied in digital format. Electronic copy of the Contract Drawings will be available at no charge to use as base plan for generation of electronic submittal. Shop Drawings shall be printed at Contract Drawing size and scale of floor plans on Shop Drawings shall match Contract Drawings.

2. All text on the drawings shall be legible without magnification when the shop drawings are reduced to 11” x 17”.

3. Provide minimum 1/8” scale floor plans with all new fire alarm control and auxiliary panels, field devices, raceway and conductor routing, quantities and connection requirements for every component.

4. Provide point-to-point system wiring diagrams showing interconnection of all new devices.

5. Provide a riser diagram showing all new devices on each NAC, SLC, and auxiliary circuit connected to the fire alarm control panel. Individual device addresses on riser diagram are not required for initial shop drawing submittal but shall be provided on the as-built drawings.

6. Provide calculations to support battery size selection. Provide voltage drop calculations for each new SLC and NAC circuit. Show the voltage drop at the furthest notification appliance from the control panel. Show all formulas and acceptable limits for all calculations. All calculations shall be shown on the shop drawings.

C. Submit shop drawings and product data to the local Fire Marshal for review and approval. All shop drawings and product data shall be reviewed and approved by the authority having jurisdiction prior to procurement and installation of materials or devices for the system.

D. Device Names: All device names that are displayed on the LCD text annunciators in the fire alarm panel and remote text annunciator panels shall be approved by the Owner. The

Contractor shall request a list of approved room names for the facility prior to programming the fire alarm panel or any field devices.

1.08 PROJECT RECORD DRAWINGS

A. Submit documents under the provisions of Division 01.

B. Accurately indicate actual locations of notification appliances, initiating devices, fire alarm control panel, annunciators, etc.

C. Provide Point to Point as-built wiring diagrams of the entire extension of the existing Life Safety System as installed. This shall include all new connected devices with actual addresses and locations of all T-taps. All drawings shall be provided in AutoCAD .DWG format. Paper plots of each sheet shall also be provided.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit operating instructions and maintenance and repair procedures under the provisions of Division 01.

B. Include manufacturer representative's letter stating the system is operational.

C. Include an 11" x 17" set of the fire alarm system project record drawings.

D. Include a completed copy of the NFPA 72 Inspection and Testing Form.

1.10 DEMONSTRATION AND TRAINING

A. The Manufacturer's Representative shall be responsible for an on-site demonstration of the operation of the system and initial staff training.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site, store and protect, under provisions of Division 01.

1.12 WARRANTY

A. The Contractor shall be able to provide initial contact on warranty service and/or service contract requests from their principal location within eight (8) hours of notification. During the warranty period, the Contractor may choose to attempt troubleshooting of the system by telephone, with the facility maintenance staff. If the problem cannot be resolved within 24 hours, the Contractor shall travel to the facility.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Existing System: Edwards Systems Technology (EST)

2.02 INITIATING DEVICES

A. Duct Mounted Smoke Detector: Addressable, NFPA 72, photoelectric type with auxiliary SPDT relay contact, duct sampling tubes extending the width of duct, and visual indication of detector activation, in duct-mounted housing. Provide with remote visual indicator, test, and reset station. Suitable for operation on existing control panel power supply and signaling line circuit.

2.03 NOTIFICATION APPLIANCES

A. All appliances shall be U.L. Listed for Fire Protective Service.

B. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to assure absolute compatibility between the appliances and the control panels, and to assure that the application of the appliances is done in accordance with the single manufacturer's instructions.

C. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

D. Fire Alarm Chime and Strobe: ANSI S3.41 and NFPA 72 compliant, flush mounted fire alarm chime with adjustable sound output level. Sound Rating: 70 dBA (reverberant) at 10 feet on the maximum volume setting and 64 dBA (reverberant) at 10 feet on the minimum volume setting. Provide minimum sound pressure level of 15 dBA above the average ambient sound level in areas where mini-horns are used. Provide integral fire alarm strobe light as specified above.

E. Notification appliances shall be listed for use on the existing fire alarm control panel power supply.

2.04 FIRE ALARM WIRE AND CABLE

A. Fire Alarm System Power Branch Circuits: Building wire as specified in Section 26 05 19.

B. Notification Appliance Circuits: Minimum #12 AWG copper building wire, as specified in Section 26 05 19.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the extension to the existing fire alarm system in accordance with the manufacturer's instructions.

B. Install all fire alarm system wiring in a dedicated fire alarm MC cable or conduit system separate from any other system wiring.

C. Detectors shall not be installed until after the construction cleanup of all trades is complete and final. Protective dust covers shall be installed on all detectors prior to final clean-up. Detectors

that have been installed without dust covers prior to final clean-up shall be replaced at no cost to the Owner.

D. Field locate remote visual indicators and test/reset stations for duct detectors in an accessible location.

E. Program the system to identify each new device with the submitted and approved designation in the LCD annunciators on the control panel and remote text annunciator if applicable.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01.

B. Test in accordance with NFPA 72 and local fire department requirements. Provide a completed NFPA 72 Inspection and Testing Form for inclusion in the Operation and Maintenance manual at the completion of testing and commissioning the extension of the existing fire alarm system.

C. Provide all equipment, devices and manpower as necessary to test each and every device in the fire alarm system both for function and supervision. Demonstrate that all devices connected to the system function properly.

D. The facility will not be accepted as substantially complete until the fire alarm system has been tested and demonstrated to the Owner's authorized representative as 100 percent complete and fully functional, a completed NFPA 72 Inspection and Testing form is submitted.

3.03 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services under provisions of Division 01.

B. Include services of a certified technician to supervise installation, adjustments, final connections, programming and system testing.

3.04 FIRE ALARM SYSTEM IDENTIFICATION

A. Wire and Cable: Provide fire alarm unit conductors with color coded insulation, or use color coded tape at each conductor termination and in each junction box as follows:

1. Power Branch Circuit Conductors: Black, red, white.

2. Initiating Device Circuit: Black, red.

3. Detector Power Supply: Violet, brown.

4. Notification Appliance Circuit: Blue (positive), white (negative).

5. Door Release: Gray, gray.

B. Identify all circuit conductors at all terminal and junction boxes per NEC 760.30. Use the circuit designations (i.e. “NAC 1”, “SLC 1”, etc.), as indicated on the shop drawings.

C. Fire Alarm Device Labels:

1. Install machine-printed device address labels on all addressable devices, including smoke/heat detectors, control relays, monitor modules, etc. Unless otherwise noted, in public spaces where devices are mounted below +80” on walls, install label on inside cover of device. At all other locations, install label on exterior cover of device. Device labels shall show the unique device address corresponding to the text annunciator description. For smoke detectors, the label shall be affixed to the base and not to the detector itself.

2. Provide label on each remote test station indicating description and location of device being tested.

D. The circuit disconnecting means for the fire alarm control panel circuit, remote power booster supply, 120V door holders, or other control equipment circuits shall have a painted red handle and handle lock. The circuit(s) shall be labeled “Fire Alarm Circuit”. The circuit assignment and panel location shall be permanently identified on all fire alarm control equipment.

END OF SECTION

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