PROJECT MANUAL:

TFSD 2023 CAPITAL IMPROVEMENTS

FOR:
TWIN FALLS SCHOOL DISTRICT NO. 411
201 MAIN AVE. W.
TWIN FALLS, IDAHO 83301

PERMIT SET
02/23/2024

Prepared By:

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HA Project No. 23010

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Civil Engineer:

Plumbing Engineer:

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HVAC Engineer:

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Electrical

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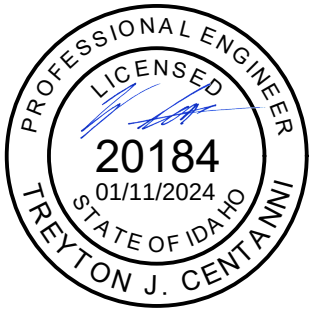
Civil Engineer:



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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

B. Project information.

C. Work covered by Contract Documents.

D. Access to site.

E. Work restrictions.

F. Specification and drawing conventions.

G. Related Requirements:

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

1.3 PROJECT INFORMATION

A. Project Identification: TFSD 2023 Capital Improvements.

B. Project Locations:

a. Package 1 – John Roper Auditorium, 1615 Filer Ave E. Twin Falls, ID 83301
b. Package 2 – Hallway Improvements at Harrison Elementary School, 600 Harrison Street, Twin Falls, ID 83301
c. Package 3 – Hallway Improvements at Morningside Elementary School, 701 Morningside Drive, Twin Falls, Idaho 83301.
d. Package 4 - Site Parking Repaving at Twin Falls High School, 1615 Filer Ave, Twin Falls, ID 83301.
e. Package 5 - Site Parking Repaving at O'Leary Middle School, 2350 Elizabeth Blvd, Twin Falls, Idaho, 83301
f. Package 6 – Support Service Classroom Tenant Improvement at Robert Stuart Middle School – 201 Main Avenue W., Twin Falls, Idaho 83301.
g. Package 7 - Restroom Remodel at O'Leary Middle School, 2350 Elizabeth Blvd, Twin Falls, Idaho, 83301
h. Package 8 - Exterior Doors Replacement at O'Leary Middle School, 2350 Elizabeth Blvd, Twin Falls, Idaho, 83301

i.

C. Owner: Twin Falls School District No. 411.

D. Contact: Ryan Bowman, Director of Educational Technology & Operations,

1. Ph. 1-208-733-6900, email: dbowmanry@tfsd.org

E. Architect: Hummel Architects PLLC, 205 N. 10th Street, Suite 300, Boise, Idaho 83702

F. Contact: Brian Coleman, Senior Associate; Ph. 208-343-7523; Fax: 208-343-0940; email: bcoleman@hummelarch.com.

Priya Raman, Senior Project Manager; Ph. 208-343-7523; Fax: 208-343-0940; Email: praman@hummelarch.com

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Reroof of Roper Auditorium at Twin Falls High School
2. Hallway (ceiling) improvements at Harrison Elementary School
3. Hallway (ceiling) improvements at Morningside Elementary School
4. Site student parking repaving at Twin Falls High School
5. Site staff parking and entry loop repaving at O'Leary Middle School
6. Support Service Classroom Tenant Improvement at Robert Stuart Middle School
7. Restroom remodel at O'Leary Middle School
8. Exterior doors replacement at O'Leary Middle School.

B. Type of Contract: Agreement Between Owner and Construction Manager/ General Contractor (CM/GC)

1.5 TEMPORARY FACILITIES AND CONTROLS

A. Use of the Owner's Existing Building and Temporary Facilities shall be under the direct control of the General Contractor.

1.6 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project. The facility is occupied during construction. Coordinate with owner for all access locations and schedules.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather tight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

B. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.

C. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.

D. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.

1. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

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

B. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

C. On-Site Work Hours: Limit work in the existing building to normal business working hours of 6:00 a.m. to 8:00 p.m., Monday through Friday, unless otherwise indicated. Coordinate with Owner.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or adjacent properties unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

E. Notify Owner’s Representative (OR) not less than two days in advance of proposed utility interruptions.

F. Obtain Owner's written permission before proceeding with utility interruptions.

G. Nonsmoking Building: Smoking is not permitted on the project site.

H. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

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

B. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

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

E. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

F. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

G. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.4 ACTION SUBMITTALS

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

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

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.

g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

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

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution will not adversely affect Contractor's construction schedule.
c. Requested substitution has received necessary approvals of authorities having jurisdiction.
d. Requested substitution is compatible with other portions of the Work.
e. Requested substitution has been coordinated with other portions of the Work.

f. Requested substitution provides specified warranty.
g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions," or form provided by Owner or Architect.

1.4 PROPOSAL REQUESTS

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

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 7 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail," or forms provided by Owner.

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

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail," or form provided by Owner.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on form provided by Owner.

B. Cumulative Cost Adjustments:

1. Cumulative claims for cost adjustment will not be allowed. Assign all cost claims directly and proportionally to specific change order items, accompanied by a detailed scheduling analysis required by division 01 Section “Construction Progress Documentation.”
2. The contractor may not reserve a right to assess impact cost, extended job site costs, extended overhead, and/or construction acceleration related to any and all changes, at a later date. Support costs or estimated costs with full schedule and cost documentation for each proposed change within the prescribed submission time. If a request for change is denied and the Contractor disputes the denial, the contractor shall supply the aforementioned documentation to support the claim in accordance with Article 16 of the Fixed Price Construction Contract (FPCC). The contractor shall waive his right to impact, extended overhead costs, and construction acceleration due to multiplicity of changes and clarifications.

1.6 CONSTRUCTION CHANGE DIRECTIVE

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

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

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

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost adjustments to the Contract.
2. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

1.7 RECONCILIATION OF CHANGE ORDERS

A. Schedule of Values: Promptly revise the Schedule of Values and Progress Payment forms to record each authorized Change Order as a separated line item and adjustment to the Contract Sum.

B. Schedules: Promptly revise Progress Schedule to reflect additional work with changes in Contract Time, revising sub-schedules to adjust time for other items of Work as may be affected by the Change. Submit revised schedules at next Progress Payment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

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

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Name of Owner/Agency.
c. Name of Owner/Agency.

d. Name of Architect.
e. Contractor's name and address.
f. Date of submittal.

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

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

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

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

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

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

1.4 APPLICATIONS FOR PAYMENT

A. Payment Application Times: Submit Application for Payment to Architect by last Monday of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

B. Application for Payment Forms: Use AIA forms for Applications for Payment.

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

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
5. Include only amounts not in dispute.

D. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site. Comply with Article 7.5 of the Fixed Price Construction Contract.

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

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

E. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

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

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Submittal schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. Copies of building permits.
8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
9. Initial progress report.
10. Report of preconstruction conference.
11. Certificates of insurance and insurance policies.
12. Performance and payment bonds.
13. Data needed to acquire Owner's insurance.

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

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

I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

B. Related Requirements:

1. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

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

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
5. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 PROJECT WEB SITE

A. TBD.

1.6 GENERAL COORDINATION PROCEDURES

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

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

B. 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. Project closeout activities.
8. Startup and adjustment of systems.

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.

1.7 COORDINATION

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

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

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

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

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

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

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

1.8 REQUESTS FOR INFORMATION (RFIs)

A. Include the following:

1. Project name.
2. Project number.
3. Date.
4. Owner/Agency.
5. Name of Contractor.
6. Name of Architect.
7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.

12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

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

B. RFI Forms: All RFI's shall be received electronically via email with embedded supporting documentation. Use form acceptable to Owner.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

C. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

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

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

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

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

D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Use CSI Log Form 13.2B or form acceptable to Owner. Include the following:

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

E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

F. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.9 PROJECT MEETINGS

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

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

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

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

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Lines of communications.
    f. Procedures for processing field decisions and Change Orders.
    g. Procedures for RFIs.
    h. Procedures for testing and inspecting.
    i. Procedures for processing Applications for Payment.
    j. Distribution of the Contract Documents.
    k. Submittal procedures.
    l. Preparation of record documents.
    m. Use of the premises.
    n. Work restrictions.
    o. Working hours.
    p. Owner's occupancy requirements.
    q. Responsibility for temporary facilities and controls.
    r. Procedures for moisture and mold control.
    s. Procedures for disruptions and shutdowns.
    t. Construction waste management and recycling.
    u. Office, work, and storage areas.
    v. Equipment deliveries and priorities.
    w. First aid.
    x. Security.
    y. Progress cleaning.

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

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

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

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

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

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

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

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

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

E. Construction Progress Meetings: Conduct progress meetings at weekly intervals.

1. The minimum agenda for Construction Progress Meeting shall include:

a. Project Number.
b. Date.
c. Attendees.
d. Previous Minutes.
e. Construction Progress Schedule Update.
f. CCD/PR/CO Status.
g. Shop Drawing/Submittal Update.
h. Material Delivery Status.
i. Pending Questions.
j. As-Built Updates.
k. Field Observations.
l. Payment Request.
m. Discussion/Action Items.
n. Next Meeting Date and Time.

2. Coordinate date of one Progress Meeting each month to coincide with preparation of payment requests.
3. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
4. Minutes: Record and distribute the meeting minutes to each party present and to parties requiring information.

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

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

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

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Contractor's construction schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

1.3 DEFINITIONS

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

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

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

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

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

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.4 INFORMATIONAL SUBMITTALS

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

1. PDF electronic file.

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

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

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

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

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

E. Daily Construction Reports: Submit at monthly intervals.

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

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

1.5 COORDINATION

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

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

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

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion, including Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use of premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

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

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

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

1. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

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

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

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

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

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

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

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

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

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

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

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.

2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

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

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

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

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
3. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 ACTION SUBMITTALS

A. Submittal Scheduling: Comply with Contractor’s Submittal Schedule, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

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

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

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual as Exhibit 1 “License Agreement for Electronic Files – Contractor.”

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

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

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

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

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

A. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

B. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

C. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

D. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL FORMAT

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

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

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

C. Options: Identify options requiring selection by Architect.

D. Deviations: Identify deviations from the Contract Documents on submittals.

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

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

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

G. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Contractor, after review, will email electronic submittals as PDF electronic files, via email, to Architect's Project Manager.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

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

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

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

a. PDF electronic file or three paper copies of Product Data unless otherwise indicated. Architect will return two copies.

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

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

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

a. PDF electronic file or three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.

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

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

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

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

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

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Submit product schedule in the following format:

    a. PDF electronic file or three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.

F. Coordination Drawings Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures.

H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

I. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

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

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

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

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

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

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

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

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

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

S. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

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

V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

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

2.2 DELEGATED-DESIGN SERVICES

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

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

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

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

3.2 ARCHITECT'S ACTION

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

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

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

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

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

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
3. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

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

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

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

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

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

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

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

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

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five 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.

1.4 CONFLICTING REQUIREMENTS

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

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

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

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

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

1.6 QUALITY ASSURANCE

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

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

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

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

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

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

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329;

and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

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

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

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
d. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

1.7 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections are the Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Engage a qualified testing agency to perform these quality-control services.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

C. Retesting/Reinspecting: Provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

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

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

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

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

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

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

1.8 SPECIAL TESTS AND INSPECTIONS

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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

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

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Standard Form of Agreement Between Owner and Construction Manager as Contractor

1. Words and terms not otherwise specifically defined in the contract mentioned above, in this Section, or in the Drawings and Specification, shall be as customarily defined by trade of industry practice, by reference standard, and by specialty dictionaries such as “Dictionary of Architecture and Construction” (Cyril M. Harris, McGraw-Hill Book Company).

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

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

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

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

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

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

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

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

1.3 REFERENCE STANDARDS, GENERAL

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 the Section or identified in individual Sections of the Specifications.

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

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

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

1.4 INDUSTRY STANDARDS

A. Applicability of Standards and Regulations: 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.

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

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

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

1.5 ABBREVIATIONS AND ACRONYMS

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

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
Idaho DBS	Idaho Division of Building Safety http://dbs.idaho.gov	(208) 334 - 3950
IDOPL	Idaho Division OF Occupational and Professional Licenses dopl.idaho.gov	(208) 334 - 3233

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
USDA	Department of Agriculture www.usda.gov	(202) 720-2791

D. 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 following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
UFAS	Uniform Federal Accessibility Standards	(800) 872-2253

	Available from Access Board www.access-board.gov	(202) 272-0080

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

Idaho DPW	Idaho Department of Administration, Division of Public Works http//:www.idaho.gov/agency/public-works-division-of	(208) 332-1900 (916) 574-2041

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

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

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

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

1.4 INFORMATIONAL SUBMITTALS

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

B. Floor Plan: Show temporary facilities, utilities, and staging areas.

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

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

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.

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

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

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

1.5 QUALITY ASSURANCE

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

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

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

D. Fire Protection: Provide fire protection program to minimize fire hazards within the Project Limits. Until Substantial Completion, fire protection within the Project Limits shall be solely the Contractor’s responsibility. At a minimum, provide adequate fire protection devices, such as portable fire extinguishers, blankets warning signs, and storage containers.

E. Hazardous Activities: During welding, brazing, and other construction activities with high fire hazard, maintain fire protection devices immediately available for use at the location of such activities.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch -thick, galvanized-steel, chain-link fabric fencing; minimum 6-feet -high with galvanized-steel pipe posts; minimum 2-3/8-inch -OD line posts

and 2-7/8-inch -OD corner and pull posts, with 1-5/8-inch -OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

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

C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60-inches. Provide in areas where contactor use path is the same as the occupied portion of the building.

2.2 TEMPORARY FACILITIES

A. Recycling: Contractor shall provide a 10 cubic yard recycling dumpster on the Project Site.

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

C. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot -square tack and marker boards.
3. Drinking water and private toilet.
4. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Lighting fixtures capable of maintaining average illumination of 20-fc at desk height.

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

1. Store combustible materials apart from building.
2. Meet specified and code required ventilation requirements of products stored.
3. Maintain temperatures specified in respective Specification Sections for product stored.

2.3 EQUIPMENT

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

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

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction, and clean HVAC system as required in Division 01 Section "Closeout Procedures."

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

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

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

B. The Contractor shall pay for all temporary utilities until Substantial Completion.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
2. When the Contractor makes arrangements through the ISU Project Manager to connect to the facility power loop for temporary power, the Contractor shall provide and install an electricity meter (which cannot be reset) at the connection to the power loop. The Contractor shall reimburse the University monthly for the prorated share of the power used until the date of Substantial Completion.

C. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Locate temporary sanitary facilities inside the lay-down/staging area indicated on Drawings.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects

of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Provide temporary site lighting for the safety of pedestrians and protection of stored materials.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.

1. Field Office shall have a land line telephone, fax, and data connection for computer to send and receive emails. The Contractor shall make arrangements with telephone services for installation of required telephone/data lines, all associated services, and long-distance charges. Alternatively, the Contractor may also make arrangements for telephone service with service providers as long as “land-lines” are provided.
2. Provide additional telephone lines for the following:

    a. Provide a dedicated telephone line for each facsimile machine in each field office.
    b. Provide one telephone line for Owner’s use.

3. At each telephone, post a list of important telephone numbers.

    a. Police and fire departments.
    b. Ambulance service.
    c. Contractor's home office.
    d. Contractor's emergency after-hours telephone number.
    e. Architect's office.
    f. Engineers' offices.
    g. Owner's office.
    h. Principal subcontractors' field and home offices.

4. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30-feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proof-rolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants
3. Traffic Routing: Prior to start of Work, determine the routing of construction vehicles, and the safeguards and procedures necessary to carry out the Work. Obtain Owner’s approval of such routing.

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

2. Maintain and touchup signs so they are legible at all times.

E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

F. Temporary Use of Permanent Stairs: Use of existing stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

G. Provide and maintain in conformance with Safety regulation all miscellaneous temporary construction aids required for the proper and safe execution of the Work, including, but not limited to:

1. Ladders, amps, and railings.
2. Scaffolds, hoists, and bunkers.
3. Chutes, barricades and enclosures.
4. Platforms, swing staging, and walks.

H. Locate temporary construction aids in and about the Work in such a position as practicable, and where they will not interfere with the progress of the Work. Remove at completion of the Work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section "Summary."

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

1. Extent of Fence: Within limits of construction activities as indicated on Drawings, to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

D. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

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

F. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

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

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

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

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

I. Welding Activities: Provide and maintain all forms of protection necessary to prevent damage resulting form welding to:

1. All previously installed materials and equipment.
2. All materials and equipment intended for use in the Work.

3.5 OPERATION, TERMINATION, AND REMOVAL

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

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

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Maintain signs and supports in a neat, clean condition. Repair all damage and weathering to structure, framing and sign panels.
3. Relocate informational signs as required by progress of the Work.
4. In the event of loss or damage, promptly restore temporary construction facilities and controls by repair or replacement with no charge to the Contract Sum or Contract Time.

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

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

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove all temporary project identification signs and informational signs.
3. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
4. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.3 DEFINITIONS

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

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

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

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

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

    a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. 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 determine compliance with the Contract Documents and to determine 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. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
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 liquids from freezing.

1.7 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 Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

a. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product,

that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

   a. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

   a. Where incorporation of a comparable product into the Work requires revisions to the Contract Documents and/or additional work to accommodate the proposed product, any and all resulting additional construction costs shall be paid for, in full, by the entity proposing the comparable product.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction Layout.
2. Installation of the Work.
3. Cutting and patching.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in

Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, notify Architect promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Level foundations and piers from two or more locations.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during demolition, cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during demolition, cutting, and patching operations.

E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements"

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 03 through 40 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
2. Section 078413 "Penetration Firestopping" for patching fire-rated construction.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include, but are not limited to, the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.
9. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include, but are not limited to, the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
3. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.

Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection 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.

1.7 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Electronic Archive:

1. The contractor is required to archive the project electronically and issue copies of the archive to the Owner and the Architect. See section 013100 Project Management and Coordination.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:

    a. One PDF electronic file. Architect will return annotated copy, or
    b. Three paper copies unless otherwise indicated. Architect will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-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.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. 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.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

2. Or three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.

5. Special operating instructions and procedures.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy or one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy or one annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file and one paper copy.
3. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file of marked-up paper copy of Specifications and one paper copy.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file and one paper copy.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file and one paper copy submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and one PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project record documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.

f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Narration: Describe scenes on video recording. Include description of items being viewed.

D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 PRE-INSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Demolition Plan: Submit a detailed plan and schedule describing the sequence of demolition and the protection and maintenance of:

1. Egress
2. Fire Dept. Access
3. Building weather tightness
4. Student Safety
5. Existing construction to remain

B. Qualification Data: For refrigerant recovery technician.

C. Predemolition Photographs or Video: Submit before Work begins.

D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.6 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. **The Prime Contractor is responsible for the removal of hazardous materials. Per the City of Twin Falls code, Asbestos NESHAP regulations apply.**
2. The Owner will hire an independent Testing Agency to observe and test for hazardous materials during construction.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

D. Survey of Existing Conditions: Prior to construction start, record existing conditions by use of preconstruction photographs and video.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.

4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

B. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    c. Structural 1, B-B or better; mill oiled and edge sealed.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 1/2 by 1/2 inch, maximum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150, Type I (interior) or Type IA (exterior), gray.
2. Fly Ash: ASTM C 618, Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.

C. Normal-Weight Aggregates: ASTM C 33, Class 3M (exterior) Class 1N (interior) coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

F. Water: ASTM C 94 and potable.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 15 mils thick.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, ¼" thickness.

B. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inchthick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Slag Cement: 50 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 (exterior) and 1.00 (interior) percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: See Drawings
2. Maximum W/C Ratio: See Drawings.
3. Slump Limit: See Drawings.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: See Drawings
2. Maximum W/C Ratio: See Drawings.
3. Slump Limit: See Drawings.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: See Drawings
2. Maximum W/C Ratio: See Drawings.
3. Slump Limit: See Drawings.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls at 16’-0” on center.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x hbefore and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inchesdeep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inchin any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg Fand below or 80 deg Fand above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 033000

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SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Mortar and grout materials.
3. Reinforcement.
4. Ties and anchors.
5. Embedded flashing.
6. Accessories.
7. Mortar and grout mixes.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.

C. Related Requirements:

1. Section 072100 "Thermal Insulation" for cavity wall insulation.
2. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
3. Section 096313.35 "Chemical-Resistant Brick Flooring" for chemical-resistant, interior brick flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Clay face brick.
2. Colored mortar.
3. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick.
2. Weep/cavity vents.
3. Cavity drainage material.
4. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of the following:

1. Masonry units.

    a. Include data on material properties.
    b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.

2. Mortar admixtures.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 MOCKUPS

A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall in sizes approximately 48 inches long by 48 inches high.
2. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units from single source or manufacturer.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBX.

1. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
2. Application: Use where brick is exposed unless otherwise indicated.
3. **Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.**

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

E. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, **as selected from manufacturer's standard colors to match adjacent existing brickwork.**

F. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.

G. Aggregate for Grout: ASTM C404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

a. GCP Applied Technologies Inc.
b. Euclid Chemical Company (The); an RPM company

2.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

a. Euclid Chemical Company (The); an RPM company.
b. GCP Applied Technologies Inc.
c. Master Builders Solutions.

J. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.

2. Stainless Steel Wire: ASTM A580/A580M, Type 304.
3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long for masonry constructed from solid units.
2. Wire: Fabricate from [**3/16-inch-**] [**1/4-inch-**] diameter, hot-dip galvanized steel wire.

2.6 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with sawtooth ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for sawtooth metal flashing from plain metal flashing of same metal as sawtooth flashing and extending at least 3 inches into wall with hemmed inner edge to receive sawtooth flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
8. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
9. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
10. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
11. Solder metal items at corners.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a butyl adhesive, to produce an overall thickness of 10 mil.

a. Applications: Use 10-mil- thick flashing at windows, doors, and small wall penetrations; not at base of walls. Use 40-mil- thick flashing at base of walls.

C. Drainage Plane Flashing: Fabricate from stainless steel and drainage membrane to shapes indicated, including weep tabs, termination bar, and drip edge. Provide flashing materials as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.

2. Fabricate continuous flashings in sections 60 inches long, minimum.
3. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Stainless steel bars 0.075 inch by 1 inch.

F. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8-inch sealant flange at top.

2.7 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vents: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. Use only for weeps.
2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
3. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector: Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.

    1) Hohmann & Barnard, Inc.; Mortar Trap.
    2) Advanced Building Products Inc.; Mortar Break DT.

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.

3. For exterior masonry, use portland cement-lime mortar.
4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
2. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
3. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
4. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
5. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in a pattern to match existing adjacent brick masonry do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

D. Cut joints flush where indicated to receive waterproofing cavity wall insulation air barriers unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 36 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches

of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.

2. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide not less than 1 inch of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Install preformed control-joint gaskets designed to fit standard sash block.
2. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
3. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.

D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide lintels where indicated and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe.
2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
4. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges and sealant stops with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.
7. , masonry does not extend more than 24 inches above top of pea gravel.

E. Place cavity drainage material in cavities airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.11 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
6. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Miscellaneous steel trim.
3. Loose steel lintels.

B. Related Sections include the following:

1. Division 03 Section 033000 Cast-In-Place Concrete

C. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.3 ACTION SUBMITTALS

A. Product Data: For paint products and grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0677-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum or stainless steel.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inchesby length indicated with anchor straps or studs not less than 3 inches long at not more than 8 incheso.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that are compatible with intermediate and topcoats specified in Section 099113 "Exterior Painting" and Section 099123 Interior Painting."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 4500 psi, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

2.7 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.8 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Galvanize loose steel lintels located in exterior walls.

2.9 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers that are compatible with intermediate and topcoats specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

INSTALLING BEARING AND LEVELING PLATES

F. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

G. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with non-shrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

H. ADJUSTING AND CLEANING

I. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

J. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

K. END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with timber.
3. Framing with engineered wood products.
4. Shear wall panels.
5. Rooftop equipment bases and support curbs.
6. Wood blocking, cants, and nailers.
7. Wood furring and grounds.
8. Plywood backing panels.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominalsize in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Engineered wood products.
3. Shear panels.
4. Power-driven fasteners.
5. Post-installed anchors.
6. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: See drawings.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load bearing.
2. Species:

a. Hem-fir (north); NLGA.
b. Southern pine or mixed southern pine; SPIB.
c. Spruce-pine-fir; NLGA.
d. Hem-fir; WCLIB, or WWPA.
e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
f. Northern species; NLGA.
g. Eastern softwoods; NeLMA.

h. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions: See drawings for grade.

1. Application: Interior load-bearing partitions.
2. Species:

a. Douglas fir-larch; WCLIB or WWPA.

C. Ceiling Joists: Construction or No. 2 grade.

1. Species:

a. Douglas fir-larch; WCLIB or WWPA.

D. Joists, Rafters, and Other Framing Not Listed Above: Construction or No. 2 grade.

1. Species:

a. Douglas fir-larch; WCLIB or WWPA.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inchthick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

E. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.

1. Thickness: 0.050 inch.

F. Hold-Downs: See Drawings.

G. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16-inch-deep by 0.034 inch thick with hemmed edges.

H. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

M. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with indicated fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring horizontally at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 incheso.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominalthickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-6-inch nominal-size wood studs spaced 16 incheso.c. unless otherwise indicated.

2. For interior partitions and walls, provide 2-by-4-inch nominal-size wood studs spaced 16 incheso.c. unless otherwise indicated.
3. Provide continuous horizontal blocking at midheight of partitions more than 96 incheshigh, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominaldepth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

3.5 CEILING JOIST FRAMING INSTALLATION

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior wall sheathing - Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing

B. Related Requirements:

1. Section 06100 “Rough Carpentry” for substrate for exterior sheathing.
2. Section 072100 “Thermal Insulation” for extruded polystyrene board wall insulation.
3. Section 072713 “Plastic Sheet Air Barrier”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

A. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M, Type DGG, coated fiberglass mat gypsum sheathing with integral weather-resistant barrier and air barrier complying with ASTM E2178.

1. Basis-of-Design Products: Subject to compliance with requirements, provide **Georgia Pacific Gypsum, LLC; DensElement**, or comparable product by one of the following:

a. USG Corporation; Securock ExoAir 430.

2. Thickness: 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.
4. Edges: Square.
5. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
6. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference when tested according to ASTM E2178.
7. Vapor Permeance: Minimum 20 perms when tested according to ASTM E96/E96M, Desiccant Method, Procedure A.
8. Sheathing Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested according to ASTM E2357.
9. Fire Propagation Characteristics: Complies with NFPA 285 testing as part of an approved assembly.
10. Combustion Characteristics, ASTM E 84: Class A, flame spread, not greater than 25; smoke developed, not greater than 450.
11. VOC Content: Less than 50 g/L.
12. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

B. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by sheathing manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. 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. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

END OF SECTION 061600

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

B. Section includes:

1. Plastic-laminate-clad architectural cabinets and countertops.
2. Cabinet hardware.

C. Related Requirements:

1. Division 09 Sections “Resilient Base and Accessories,” for base materials installed against base cabinets.
2. Division 22 “Plumbing,” Division 26 “Electrical,” and Division 27 “Communications” Sections for sinks, service fixtures, plumbing fixtures, electrical service, light fixtures and appurtenances, and data lines installed in cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples for Verification:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

a. Provide one 12” x 12” sample with plastic laminate applied to core material with specified edge material applied to one edge.

2. Edge material for each p-lam for each condition; drawers, doors and countertops.
3. Exposed Casework Hardware: one of each type and finish

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

B. Qualification data for firms and persons specified in “Quality Assurance” article to demonstrate their capabilities and experience. Include list of completed projects of similar scope and size with project names, addresses, names of Architects and Owners, and other information specified.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For cabinet finishes to include in maintenance manuals. Include cleaning instructions.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Manufacturer of casework.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

B. All materials and workmanship covered by this section will carry a 5-year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Grade: Unless otherwise indicated, provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade VGS.

G. Edges. Basis of Design is listed below. Alternates may be submitted to the Architect for review and approval prior to bidding. All edge banding to be submitted for review and approval prior to ordering.

1. 1mm PVC Edge Banding (for semi-exposed edges such door and drawer edges): Color, finish and pattern as follows:

a. **PL-1** - Use Wilsonart edge banding to match PL-1, or Architect approved equal.
b. **PL-3** - Use Wilsonart edge banding to match PL-1, or Architect approved equal.

2. 3mm PVC Edge Banding (for countertop edges): Color, finish and pattern to match plastic laminate on surface.

a. **PL-2 -** Use Wilsonart 3mm edge banding, to match PL-2.

b. **PL-4 -** Use Wilsonart 3mm edge banding, to match PL-2.

3. 1mm PVC Edge Banding (for melamine edges at open melamine shelving (Mail Room)): Color, finish and pattern as follows:

a. Use Rehau C700055, 15/16” x 1mm pvc edgebanding

H. Pattern Direction: Vertically for doors and fixed panels. Vertically for drawer fronts.

I. Materials for Semi exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.
4. Open Shelving: thermoset decorative panels.

J. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

K. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

L. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Decorative Laminates for Exposed Surfaces: Architect's Basis of Design:

a. PL-1 (@ ROBERT STUART): Wilsonart Mushroom 5013K in Leno Weave Finish.,
b. PL-2 (@ ROBERT STUART): Wilsonart Steel Mesh in Fine Velvet Finish.,
c. PL-3 (@ O’LEARY): Wilsonart Mushroom 5013K in Leno Weave Finish., as selected from Manufacturer’s full range.
d. PL-4 (@ O’LEARY): Wilsonart Steel Mesh in Fine Velvet Finish.,

2.2 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Edge Treatment: 3 mm vinyl edge banding to match counter thickness indicated.

D. Core Material: Particleboard.

E. Core Material at Sinks: Exterior-grade plywood.

F. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertops substrate.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Core Materials:

a. Particleboard up to 7/8-inch-thick: Industrial Grade average 47-pound density particleboard, ANSI A208.1-1999, M-3
b. Particleboard 1 inch thick and thicker: Industrial Grade average 45-pound density particleboard, ANSI A208.1-1999, M-2
c. MR Moisture Resistant Particleboard: Average 47-pound density grade, ANSI A209.1 1-1999, M-3
d. Medium Density Fiberboard ¼-inch-thick: Average 54-pound density grade, ANSI A208.2
e. Medium Density Fiberboard ¾-inch-thick: Average 48-pound density grade, ANSI A208.2

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

C. Concealed Hinges:

1. Hinge: Blum Clip top 170-deg. #71T6580, self-closing, for press-in application.
2. Hinge Clip: OMM Clip – 175H7100, OMM #6 WD Blum.

D. Wire Pulls: Back mounted, stainless steel, 4 inches long, 5/16 inch in diameter.

1. Color; “Antique Nickel”, finish to be approved by Architect prior to purchasing.

E. Shelf Rests: BHMA A156.9, B04013; metal.

F. Concealed Shelf Supports (for Laminate-Clad, Freestanding Shelves):

1. Triad XXL Concealed Mounting Bracket #1621712G, zinc finish, with #1622510 Triade Profile Support for Drywall, as manufactured by Richelieu (800) 619-5446, or equal.

G. Drawer Slides: BHMA A156.9.

1. Side-mounted, zinc-plated steel drawer slides with steel ball bearings and rated for the following loads:
2. Box and Pencil Drawer Slides: 100 lbf “Blum Standard Series” 15-inches bottom mounted, self-closing, three-quarter extension.

a. File Drawer Slides: 200 lbf “Blum Standard Series” 20-inch bottom mounted, self-closing, full extension.
b. Printer Shelf Slides: 200 lbf “Blum” 20-inch bottom mounted, self-closing, full extension.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive specified above for faces.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Caulk space between countertop and wall tile with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

D. Remove and dispose of all packing materials and related construction debris

E. Apply temporary non-adhesive protective covering on countertops until substantial completion. Clean cabinets as specified in 3.3.C. after removing temporary covering.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Polyisocyanurate foam-plastic board insulation for cavity wall veneer wall insulation
2. Spray polyurethane (wall) insulation.
3. Glass-fiber blanket insulation.
4. Polyisocyanurate Roof Insulation.

B. Related Sections:

1. Section 061600 “Sheathing”
2. Section 072800 “Air sealing” for use of spray polyurethane air barrier.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, Foil Faced (PIC-1): ASTM C1289, foil faced, Type I, Class 1 or 2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Atlas Roofing Corporation; EnergyShield Pro.
b. Carlisle Coatings & Waterproofing Inc.; R2+ Sheathe Foil Faced.
c. DuPont; Thermax (ci) Exterior Insulation.
d. Firestone Building Products; Enverge CI Foil.
e. Hunter Panels; Xci Class A Foil.
f. Rmax, Inc; ECOMAXci.

2. Use For:

a. Cavity Wall Insulation.
b. Veneer Wall Insulation.
c. Metal Clad Exterior Wall Insulation.
d. As indicated on Drawings.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

a. Suitable for use in fire-resistance-rated and Type I and Type II construction.

4. Potential Heat: NFPA 259 compliant.
5. Service Temperature Range: -40 deg F to +250 deg F.
6. Compressive Strength: Minimum 25 psi, per ASTM D1621.
7. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

a. R-value: Minimum 6.5 per inch, 180-day age at 75 deg F.

B. Adhesive for Bonding and Sealing Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates, and seal joint and penetrations in board insulation.

C. Joint Tape: Self-adhering seam tape of type recommended by insulation manufacturer for sealing joints and penetrations in board insulation.

D. Liquid Flashing: Product with demonstrated capability to seal insulation joints and provide flashing at wall openings and penetrations in board insulation.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

D. Thickness/R-Value:

1. 3-5/8 inches / R-13.
2. 5-1/2 inches / R-21.

2.3 SOUND ATTENUATION BLANKET INSULATION

A. Unfaced, Glass-Fiber Blanket I

B. Insulation:

1. Available Manufacturers:

a. CertainTeed Corporation.
b. Guardian fiberglass, Inc.
c. Johns Manville.
d. Knauf Fiber Glass.
e. Owens Corning.

2. Thickness 3 ½ inches (90 mm).
3. Thickness 5 ½ inches (140 mm)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which spray polyurethane foam and air/vapor barrier systems will be applied, with installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. Do not proceed with the installation until after minimum concrete curing period recommended by manufacturer
2. Ensure that:

    a. surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
    b. concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
    c. masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.

3. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Notify Architect in writing of anticipated problems using spray polyurethane foam and or air/vapor barrier over substrate.

3.2 SURFACE PREPERATION

A. Substrate preparation for spray polyurethane foam and or air/vapor barrier applications

1. Refer to manufacturer’s literature for more specific requirements of preparation of substrates.
2. Surfaces shall be free of contaminants such as grease, oil and wax on surfaces to receive spray polyurethane foam and or air/vapor barrier applications
3. Polyurethane foam should not be UV degraded beyond the point where the surface is friable and will provide poor adhesion
4. Fill all voids and holes greater than ½ inch.
5. All penetrations should be grouted, bridged with membrane or flashing, or filled with sealant.
6. If the surfaces cannot be made smooth to the satisfaction of the Architect, it will be the responsibility of the trade to alternatively apply a parge coat (typically one part cement to three parts sand) over the entire surface to receive the membrane.
7. Remove mortar droppings on brick ties, shelf angles, brick shelves or other horizontal obstructions.
8. Clean, prepare, and treat substrate according to manufacturer’s written instructions. Provide clean, dust-free, and dry substrate for spray polyurethane foam and or air/vapor barrier applications.
9. Fill joints greater than ¼” between exterior sheathing panels with with sealant, tape, or caulk acceptable to manufacturer.

3.3 INSTALLATION, GENERAL

A. PREPARATION

1. Clean substrates of substances that are harmful to oinsulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or interfere with insulation attachment.

B. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

C. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

D. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF CAVITY-WALL AND VENEER-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.

1. Press units firmly against inside substrates.
2. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."
3. Seal joints between board insulation units by applying joint tape or liquid joint sealer, according to manufacturer's recommendations.

B. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Support insulation mechanically, using "Z" furring and manufacturer's recommended insulation hangers , or other support system recommended by insulation manufacturer.
3. Press units firmly against inside substrates.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Extruded polystyrene wall board: Comply with manufacturer's written instructions:

1. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.7 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wrap.

2. Flexible flashing.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing joint and penetration treatment.

2. Section 072100 “Thermal Insulation” for continuous insulation over building wrap.

3. Section 072713 "Modified Bituminous Sheet Air Barriers" for sheet air barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap. (6.7 perms)

b. Insulation Solutions, Inc.; Raptor Plus (7 perms)

c. Specialty Coating and Laminating LLC; Barricade Building Wrap. (10.4 perms)

d. Pactiv Building Products; GreenGuard Max. (16 p)

2. Water-Vapor Permeance: Between 5 and 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).

3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.

4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch, and recommended in writing by the building wrap manufacturer..

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.

2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.

2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.

2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.

3. Lap flashing over water-resistive barrier at bottom and sides of openings.

4. Lap water-resistive barrier over flashing at heads of openings.

5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 072800 – AIR SEALING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes labor, materials, products, equipment and services for the following:

1. Air sealing to supplement and provide continuity of the main or primary air barrier assembly, including the bridging, sealing and/or filling of perimeter of building components and systems such as, but not limited to: door and window openings, crevices, roof-wall connections, mechanical and electrical penetrations in walls, floors and roofs, entrances and storefronts, mullions, beam and column enclosures, and voids in walls.
2. Air seal at openings in walls, floors and roofs at mechanical and electrical penetrations, openings at each floor level in shafts or stairwells, and penetrations through construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

B. Related Sections include the following:
1. Section 017300 – Execution (for cutting and patching requirements).
2. Section 033000 – Cast-In-Place Concrete (for slabs and walls).
3. Section 061600 – Sheathing
4. Section 072100 – Thermal Insulation.
5. Section 072713 – Plastic Sheet Air Barriers
6. Section 079200 – Joint Sealants
7. Section 081113 – Hollow Metal Doors and Frames.
8. Section 084113 – Aluminum-Framed Entrances and Storefronts.
9. Section 092900 - Gypsum Board.
10. Division 09 – Painting Sections.
11. Division 22 – Plumbing Sections.
12. Division 23 – Mechanical Sections.
13. Division 26 – Electrical Sections.

1.03 REFERENCES

A. Reference Standards:

1. NFPA: Foam plastics left exposed to the interior occupied space must be covered by a thermal barrier or show compliance to NFPA 286for flame spread classifications for specific materials or assemblies.
2. For rough openings of fenestrations sealants must conform to AAMA 812-04.
3. Sealants must have ASTM E-84 or UL723 standard testing for surface burning characteristics of building materials.
4. Sealants must be UL classified for foamed plastics as per UL 723 for caulking and sealants
5. ICC-ES AC377 acceptance criteria for spray applied foam plastic insulation.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data for materials, providing descriptions sufficient for identification at the Project site. Include manufacturer's printed instructions for installation.

B. Maintenance Manuals: Provide 2 copies including product literature and sources of repair materials.

1.4 QUALITY ASSURANCE

A. Provide the work of this Section using qualified installers, experienced in the application of the materials and systems being used.

B. Regulatory Approvals:

1. Conform to applicable local building codes for fire resistance ratings and surface burning characteristics.
2. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

C. Pre-installation Conference:

1. Convene at least one week prior to commencement of work of this Section, at Project site.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when temperature or weather conditions deviate from manufacturer's recommendations. Comply with manufacturer's recommended requirements for temperatures, relative humidity, and substrate moisture content during application and curing of materials.

B. Ensure proper ventilation in areas to receive solvent and moisture cured materials, and in enclosed spaces when installing two-component foam sealant.

C. Comply with manufacture’s MSDS Sheets for use and handling of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products undamaged in original containers with manufacturer's labels and seals intact.

B. Do not store at temperatures above 120 degrees F. Avoid prolonged storage in direct sunlight or near heat sources. Avoid prolonged storage in direct sunlight or near heat sources.

C. Protect Foam Sealant Air System materials from physical damage and from deterioration due to moisture, soiling and other sources. Store inside and in a dry location. Comply with manufacturer’s written instructions for handling, storing and protecting during installation.

D. Install materials in strict compliance with manufacturer’s written installation instructions.

1.7 SEQUENCING AND SCHEDULING

A. Do not install work of this Section until work of other trades having an effect on this Section of work has been completed.

B. Schedule work of other trades so that foam sealants can be inspected prior to being covered by subsequent construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers of insulating spray foam system for walls having products considered acceptable for use:

    a. The Dow Chemical Company.
    b. Or approved equal.

2.2 MATERIALS

A. CLASS A - Insulating air sealant: Polyurethane Foam: Two-component chemically-cured spray-applied polyurethane foam with the following characteristics:

    1. Manufacturer: The Dow Chemical Company.

        a. Product: FROTH-PAK™ Foam Sealant (or other full trade name)

B. Formed-in-Place Sealant – General Purpose Type: single-component polyurethane sealant. Gun-applied and Straw-applied products, Thermal Value R3.5 per inch. Refer to Dow product literature to determine applicable application technique.

    1. Manufacturer: The Dow Chemical Company

        a. Product: GREATSTUFF PRO™ Gaps & Cracks Insulating Foam Sealant:

            1) Substrate Cleaner: recommended by foam sealant manufacturer.

C. Foamed-in-Place Sealant – Low Foaming Pressure: single-component polyurethane sealant low expansion pressure specifically designed for window and door application.

D. Gun-applied and Straw-applied products, Thermal Value R3.5 per inch. Refer to Dow product literature to determine applicable application technique.

    1. Manufacturer: The Dow Chemical Company

        a. Product: GREAT STUFF PRO™ Window & Door Insulating Foam Sealant:

            1) Clean substrate per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect existing conditions to ensure they are suitable for product application. Do not proceed until unacceptable conditions are corrected.

B. Examine sizes and conditions of voids to be air sealed to establish correct thicknesses and installation of materials per manufacture’s recommendations.

C. Verify that surfaces are ready to accept the work of this Section and penetrating elements are securely fixed, properly located and with the required space allowance between penetrants and openings.

D. Do not proceed with work of this Section until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate surfaces to remove moisture, dirt, dust, grease, oil, loose material, or other matter which may affect bond of foam sealant or air seal material. Ensure surfaces are dry before proceeding with installation.

B. Remove incompatible materials which may affect bond.

C. Install backing and damming materials for air seal if required to arrest liquid material leakage and for support.

D. Mask, using masking tape, where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces. Remove tape as soon as possible without disturbing air seal or air seal with substrates.

3.3 INSTALLATION

A. Install materials in strict compliance with manufacturer’s written installation instructions.

B. Install materials in accordance with manufacturer's instructions and acceptable to authorities having jurisdiction and the Consultant to provide required air seal.

C. Apply sealants within recommended application temperature ranges. Consult manufacturer when sealants cannot be applied within specified ranges.

D. In low humidity, mist area with water to aid cure of one-component sealant.

E. Avoid overfilling restricted spaces.

F. Use one-component foam for cracks or openings 1/4" to 2" wide. Use two-component foam sealant for gaps over 2" wide, and for voids in hidden cavities.

G. Install foam sealants in accordance with authorities having jurisdiction and all other applicable regulations pertaining to sealing materials.

H. Provide continuity with the air barrier systems by sealing the following areas within the construction and construction assemblies. Please note that these areas are typical in nature and does not limit the application of these products to these noted areas but any and all details within the construction that present similar air leakage characteristics should receive similar applications. Note the following:

1. Various roof locations including penetrations of all kinds and roof to fascia junctions.
2. Window head, jamb and sill areas at cavity wall.
3. Various roof areas including sloped roof/wall junctions, penetrations of all kinds and roof/wall junctions.
4. Junction of roof air/vapor barrier and wall air/vapor barrier.
5. In cavity wall construction at roof/wall junctions, window perimeters, exhaust vents and soffits.
6. Junctions at roof scuppers and other mechanical equipment located on the roof.
7. Window frame at columns.
8. Curtain wall systems at window and metal panels.
9. At intervals in the cavity wall to achieve compartmentalization.
10. Exterior soffit overhangs in cavity wall construction.
11. Wall/roof junctions at drain scuppers and other areas where mechanical equipment is located on the roof.
12. All basement, corridor and parking garage penetrations made vertically through floors or horizontally through walls.

13. Provide reduced air leakage into and out of building(s) by sealing gaps, leaks and holes in interior and exterior construction

I. Ensure continuity of air and vapor seal between wall and window frame in accordance with the requirements of CSA A440.4 Windows standard.

J. Inspect roof perimeter for air leakage paths such as the fluted deck itself, truss and structural beam penetrations above and below the top of the wall, open mortar joints, and conduit and pipe penetrations. Use smoke tester kits to identify and locate leakage.

1. Use both one-component and two-component foam sealants in combination to create a continuous foamed-in-place seal between the wall and the root air/vapor barrier.
2. Where deck flutes run perpendicular to the wall, foam the open flutes completely out to the fascia.
3. Where closed flutes occur, punch flutes and inject foam through holes. Locate holes as close to wall as possible so that the plane of injected and cured foam within the closed flute is level with the plane of the exposed foam in the open flutes.
4. Where the steel deck is parallel to the wall, fill the void with either one-component or two-component material, depending on gap size.

3.4 FIELD QUALITY CONTROL.

A. Arrange for inspections by the Owner's independent inspection and testing company, appointed and paid for by Owner.

B. Following field inspections provide all repairs as required to ensure compliance with the Contract Documents.

3.5 CLEANING AND PROTECTION

A. Upon completion of this work, remove all materials, equipment and debris from the site.

B. Leave work area and adjacent surfaces in a condition acceptable to the Consultant.

C. Remove excess sealant per manufacturer’s recommendations.

D. Leave installed work with sufficient protection to enable it to remain untouched until project turnover.

E. Protect installed Foam Sealant Air System from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where Foam Sealant Air System is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

For exterior uses, provide a coating or painting for protection from ultraviolet radiation.

END OF SECTION 072800

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SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Substrate board.
3. Roof insulation (tapered) where resloping is required. See drawings
4. Walkways.

B. Section includes installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
2. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:

1. Concrete internal relative humidity test reports.

2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 SH.

D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.

E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.78 and an emissivity of not less than 0.75 when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- -reinforced, TPO sheet.

1. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.
2. Thickness: 60 mils, nominal.
3. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Roof Vents: As recommended by roof membrane manufacturer.

1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Manufacturer's standard.

F. Slip Sheet: ASTM D2178/D2178M, Type IV; glass fiber; asphalt-impregnated felt.

G. Slip Sheet: Manufacturer's standard, of thickness required for application.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured by TPO roof membrane manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Basis-of-Design Product: SecureShield Polyiso
2. Compressive Strength: 20 psi.
3. Size: **48 by 96 inches**.
4. Thickness: Where necessary to replace full thickness of existing insulation

a. Base Layer: 2-1/2 inches. Match existing adjacent roof insulation thickness.
b. Upper Layer:2-1/2 inches. Match existing adjacent roof thickness.

C. Tapered Insulation: Provide factory-tapered insulation boards. See drawings for locations reinstall of insulation to slope to drain.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately36 by 60 inches.
2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft.or portion thereof, of roof deck, with not less than three tests probes.
    b. Submit test reports within 24 hours after performing tests.

6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
7. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
8. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.
9. Verify any damaged sections of cementitious wood-fiber decks have been repaired or replaced.
10. Verify adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch at top surface.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

D. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition **and to not void warranty for existing roofing system**.

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Where two layers of insulation installation is necessary, Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

a. Locate end joints over crests of decking.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

2. FInstall upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

3.5 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 INSTALLATION OF WALKWAYS

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

a. Retain one or more subparagraphs below. Revise to suit Project.
b. Perimeter of each rooftop unit.
c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
e. Top and bottom of each roof access ladder.
f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
g. Locations indicated on Drawings.
h. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner:TWIN FALLS SCHOOL DISTRICT.
2. Address: 201 Main Ave W, Twin Falls, ID 83301.
3. Building Name/Type: Twin Falls High School Rooper Auditorium
4. Address: 1615 Filer Ave. E. Twin Falls, ID 83301
5. Area of Work: New TPO roofing
6. Acceptance Date: _____.
7. Warranty Period: 20 Years
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding 115 mph;
c. fire;
d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:

1. Manufactured reglets.
2. Formed low-slope roof flashing and trim.
3. Formed wall flashing and trim.
4. Formed equipment support flashing.

B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 07 Section “Thermoplastic Membrane Roofing” for installing sheet metal flashing and trim integral with roofing membrane systems.
3. Division 07 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

1. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft.: 60-lbf/sq. ft. perimeter uplift force, 90-lbf/sq. ft. corner uplift force, and 30-lbf/sq. ft. outward force.
2. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft.: 90-lbf/sq. ft. perimeter uplift force, 120-lbf/sq. ft. corner uplift force, and 45-lbf/sq. ft. outward force.
3. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft.: 208-lbf/sq. ft. perimeter uplift force, 312-lbf/sq. ft. corner uplift force, and 104-lbf/sq. ft. outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include 8-inch (203 mm) square Samples of trim and accessories involving color selection.

D. Qualification Data: For qualified fabricator.

E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

F. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are specified or shown on Drawings.

C. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall coping at composite metal wall panel, approximately 48 inches long, including supporting construction cleats, seams, attachments**,** underlayment**,** composite metal wall panels and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

D. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager and Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling in a manner to prevent bending, warping, twisting, and surface damage.

B. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Color: As selected by Architect from manufacturer's full range **to match existing adjacent where applicable.**
2) Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finishes:

a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Color: As selected by Architect from manufacturer's full **range to match existing adjacent where applicable.**
2) Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5mil.

2.2 COLD-FORMED HOLLOW STRUCTURAL SECTIONS

A. Steel Tubes for Downspouts: ASTM A 500, Grade B or C, structural tubing.

2.3 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
b. Blind Fasteners: High-strength stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cheney Flashing Company, Inc.
b. Fry Reglet Corporation.
c. Heckmann Building Products Inc.
d. Hickman, W. P. Company.
e. Keystone Flashing Company, Inc.
f. Sandell Manufacturing Company, Inc.

2. Material: Metallic-coated steel sheet, 0.022 inch thick, except provide galvanized sheet, 0.0217 inch thick, for stucco-type reglets.
3. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint and for joints sawcut into masonry and concrete walls.
4. Surface Mount Type: Anchor and seal per Manufacturer’s Recommendations.
5. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

6. Finish: With manufacturer's standard color coating.

   a. Color: As selected by Architect from manufacturer's full range **to match existing adjacent where applicable.**

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but in no case less than thickness of metal being secured.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

G. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Parapet Scuppers: Fabricate scuppers of dimensions indicated with closure flange trim to exterior, 4-inch (102 mm) wide wall flanges to interior and base extending 4 inches (102 mm) beyond cant or tapered strip into field of roof. Fabricate from prepainted, metallic-coated steel: 0.0276 inches (0.7 mm) thick.

B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge of dimensions and shape indicated complete with outlet tubes. Fabricate conductor heads of prepainted, metallic-coated steel, 0.0276 inches (0.7mm) thick.

C. Sheet Metal Downspouts (at high roofs): Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Fabricated Hanger Style: SMACNA figure designation 1-35B.
2. Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

D. Tubular Steel Downspouts (at locations accessible to the public): Fabricate open-face downspouts from 4" x 3" x 3/16-inch tube steel, shop-primed with primer compatible with finish coats specified in Division 09 Section "Exterior Painting." Furnish with metal hangers configured similar to sheet metal downspout hangers, fabricated from same material and finish as tube steel, and hanger anchors.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Furnish with 6-inch-wide, joint cover plates.

1. Joint Style: Butt, with 12-inch-wide, concealed backup plate and 6-inch-wide, exposed cover plates.
2. Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

B. Parapet Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners and seal watertight.

1. Joint Style: "Drive" style joint type "J9" per SMACNA "Chart 12-COPING DESIGN."
2. Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.0340 inch (1.02 mm) thick.

C. Base Flashing: Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.028 inch

D. Counterflashing: Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.022 inch

2.9 Flashing Receivers: Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.022 inch WALL SHEET METAL FABRICATIONS

A. Openings Flashing in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high-end dams. Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

2.10 ALUMINUM FLASHINGS

A. Where indicated on Drawings, Fabricated aluminum flashings from minimum 0.032 inchthick. Coil-coated aluminum sheet.

2.11 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws, and not less than recommended by fastener manufacturer to achieve maximum pull-out resistance, for sheet metals.

1. For Galvanized or Coil-Coated, Aluminum-Zinc Alloy-Coated Steel: Use stainless-steel fasteners.

E. Seal joints with elastomeric and/or butyl sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

F. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. If SMACNA's "Architectural Sheet Metal Manual" is not standard office practice in the area of Project, substitute another standard in this article such as "The NRCA Roofing and Waterproofing Manual."

B. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

C. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.

D. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1-inch (25 mm) below gutter discharge.

E. Sheet Metal Downspouts: Join sections with 1-1/2-inch telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
2. Provide elbows at base of downspout to direct water away from building.

F. Tube Steel Downspouts:

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
2. Connect downspouts to underground drainage system indicated.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch centers.

C. Parapet Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
2. Anchor interior leg of coping with screw fasteners and washers into elongated holes at 20-inch centers.
3. Where copings terminate into vertical faces of CMU walls, provide masonry reglet over upturned flange of coping, or provide horizontal sawcut in face of CMU and terminate coping 1-1/2-inched (38 mm) into sawcut with upturned hem. Seal the top of the reglet joint.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant. Secure in a waterproof manner by means of anchor and washer at 36-inch centers.

E. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
2. Loosely lock front edge of scupper at face of wall.
3. Seal exterior wall scupper flanges.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Masonry Reglets and Counterflashings:

1. Installation of masonry reglets in mortar joints is specified in Division 04 Section "Unit Masonry."
2. Where masonry-type reglets are installed in sawcut joints of masonry or concrete walls, sawcut the wall as follows:

    a. Protect surfaces below the sawcut from resulting water damage.
    b. Cut in a straight line, at the proper height above the roof surface per the roof manufacturer’s requirements, and to the proper depth into the wall to fully imbed the top flange.
    c. Install the top flange of the reglet into the cut joint and provide a continuous bead of sealant between the top flange and the top of the cut joint to form a watertight joint.

3. Install counterflashing and accessories into receiving portion of reglet after roof flashing membrane has been installed up the vertical surface of the wall per the membrane manufacturer’s requirements.

C. Openings Flashing in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

D. Extend horizontal opening flashings in masonry construction to nearest vertical joint adjacent to opening and provide 2-inch (51 mm)–high end dam on each end of flashing.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Seal flashing with elastomeric sealant to equipment support member.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

B. Related Requirements:

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Qualification Data: For installer.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. COORDINATION

C. Coordinate: Construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

D. Coordinate: Sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Manufacturer: Subject to compliance with requirements, provide products by one the following:
2. HILITI, Inc.
3. Specified Technologies, Inc.
4. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

D. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Butyl-rubber based joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction field-adhesion-test reports.

C. Sample warranties.

1.4 QUALITY ASSURANCE

a. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

b. Preinstallation Conference: Conduct conference at Project site.

c. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build an integrated mockup of exterior wall, approximately 3m (10 feet) long by 3m (10 feet) high by full thickness, including face and backup materials and accessories, in area directed by Architect. Coordinate construction of mockup with appropriate subcontractors.
2. Protect accepted mockups from the elements with weather-resistant membrane.

3. Approval of mockups if for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 SILICONE JOINT SEALANTS

A. Single Component, Neutral-Curing Silicone Joint Sealant **SS-1**: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Dow Corning Corporation.
    b. GE Advanced Materials - Silicones.
    c. May National Associates, Inc.
    d. Pecora Corporation.
    e. Sika Corporation; Construction Products Division.
    f. Tremco Incorporated.

2. Type: Single component (S).
3. Grade: Nonsag (NS)].
4. Class: 100/50.
5. Uses Related to Exposure: Nontraffic (NT).

B. Single Component, Pourable, Neutral-Curing Silicone Joint Sealant **SS-2**: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Dow Corning Corporation.
    b. May National Associates, Inc.
    c. Pecora Corporation.
    d. Tremco Incorporated.

2. Type: Single component (S).
3. Grade: Pourable (P).
4. Class: 100/50.
5. Uses Related to Exposure: Traffic (T).

2.3 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant **US-1**: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BASF Building Systems.
    b. Bostik, Inc.
    c. Lymtal, International, Inc.
    d. May National Associates, Inc.

e. Pacific Polymers International, Inc.
f. Pecora Corporation.
g. Polymeric Systems, Inc.
h. Schnee-Morehead, Inc.
i. Sika Corporation; Construction Products Division.
j. Tremco Incorporated.

2. Type: Single component (S).
3. Grade: Nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Nontraffic (NT).

B. Urethane Joint Sealant **US-2**: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Building Systems.
b. Bostik, Inc.
c. May National Associates, Inc.
d. Pecora Corporation.
e. Polymeric Systems, Inc.
f. Schnee-Morehead, Inc
g. Sika Corporation; Construction Products Division.
h. Tremco Incorporated.

2. Type: Single component (S).
3. Grade: Pourable (P).
4. Class: 25.
5. Uses Related to Exposure: Traffic (T).

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant **LS-1**: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Building Systems.
b. Bostik, Inc.
c. May National Associates, Inc.
d. Pecora Corporation.
e. Schnee-Morehead, Inc.
f. Tremco Incorporated.

2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealant **RS-1**: ASTM C 1311.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bostik, Inc.
b. Pecora Corporation.

2.6 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 EXTERIOR JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces **JS-1**.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.

2. Joint Sealant: Silicone Sealant **SS-2**.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces **JS-2**.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.

b. Joints between adjacent precast concrete units.
c. Control and expansion joints in unit masonry.
d. Joints in exterior insulation and finish systems.
e. Joints between different materials listed above.
f. Perimeter joints between materials listed above and frames of doors, windows, and louvers.

2. Joint Sealant: Silicone Sealant **SS-1** or Urethane Sealant **US-1**.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Concealed mastics **JS-3**.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based Sealant **RS-1**.

3.4 INTERIOR JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces **JS-4**.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Other joints as indicated.

2. Joint Sealant: Urethane Sealant **US-2**.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces **JS-5**.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

2. Joint Sealant: Latex Sealant **LS-1**.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 087400 “Wireless Access Control” for access controls for hollow-metal doors.
3. Section 08800 “Glazing” for glazing for hollow-metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door Products; an Assa Abloy Group company.
2. Commercial Door & Hardware Inc.
3. Curries Company; an Assa Abloy Group company.
4. Custom Metal Products.
5. Deansteel.
6. Door Components, Inc.
7. Mesker Door Inc.
8. MPI Group, LLC (The).
9. Pioneer Industries, Inc.
10. Republic Doors and Frames.
11. Security Metal Products Corp.

12. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated, cold-rolled steel sheet (unless noted otherwise) minimum thickness of 0.042 inch.
    d. Edge Construction: Model 1, Full Flush.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

    a. Materials: Uncoated steel sheet (unless noted otherwise) minimum thickness of 0.053 inch.
    b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

1. Physical Performance: Level A according to SDI A250.4.

2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Edge Construction: Model 1, Full Flush.
e. Core: Polystyrene Polyurethane.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 11.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

3. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 088000 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

    c. Compression Type: Not less than two anchors in each frame.
    d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with hairline joints.

1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
2. Provide loose stops and moldings on inside of hollow-metal work.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Mullions: Join to adjacent members by welding.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

1. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Metal-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood doors for opaque finish.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory-machining criteria.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Clearances and undercuts.
7. Requirements for veneer matching.

C. Samples: For factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

PART 2 - PRODUCTS

2.1 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

2.2 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

1. Algoma hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Door Systems, Inc.
4. Marshfield Door Systems, Inc.
5. Mohawk Doors; a Masonite company
6. Oshkosh Door Company.
7. Poncraft Door Company.
8. Vancouver Door Company.
9. VT Industries, Inc.
10. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
11. Grade: Premium.
12. Faces: Single-ply wood veneer not less than 1/50 inch thick.

    a. Species: Select white maple (match existing).
    b. Cut: Plain sliced (flat sliced).
    c. Match between Veneer Leaves: Book match.
    d. Assembly of Veneer Leaves on Door Faces: Running match.
    e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
    f. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.

13. Exposed Vertical Edges: Same species as faces - Architectural Woodwork Standards edge Type A.
14. Core for Non-Fire-Rated Doors:

    a. ANSI A208.1, Grade LD-2 particleboard.

        1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
        2) Provide doors with WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

    b. WDMA I.S. 10 structural composite lumber.

        1) Screw Withdrawal, Face: 475 lb.
        2) Screw Withdrawal, Edge: 475 lb.

15. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.3 LIGHT FRAMES

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

D. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099123" Interior Painting."

2.5 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
3. Staining: None required.
4. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
c. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 06 Section "Rough Carpentry"
2. Division 06 Section "Finish Carpentry"
3. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
4. Division 08 Sections:

    a. "Metal Doors and Frames"
    b. "Flush Wood Doors"
    c. "Aluminum-Framed Entrances and Storefronts"

5. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
6. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.2 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.3 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

    a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
    b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

    a. Wiring Diagrams: For power, signal, and control wiring and including:

        1) Details of interface of electrified door hardware and building safety and security systems.
        2) Schematic diagram of systems that interface with electrified door hardware.
        3) Point-to-point wiring.
        4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

    a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:

    a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
    b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
    c. Indicate complete designations of each item required for each opening, include:

        1) Door Index: door number, heading number, and Architect's hardware set number.
        2) Quantity, type, style, function, size, and finish of each hardware item.
        3) Name and manufacturer of each item.
        4) Fastenings and other pertinent information.
        5) Location of each hardware set cross-referenced to indications on Drawings.
        6) Explanation of all abbreviations, symbols, and codes contained in schedule.
        7) Mounting locations for hardware.
        8) Door and frame sizes and materials.
        9) Degree of door swing and handing.
        10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:

    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:

    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:

a. Fire door assemblies, in compliance with NFPA 80.
b. Required egress door assemblies, in compliance with NFPA 101.

1.4 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

a. For door hardware: DHI certified AHC or DHC.
b. Can provide installation and technical data to Architect and other related subcontractors.
c. Can inspect and verify components are in working order upon completion of installation.
d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.

b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2) Preliminary key system schematic diagram.
3) Requirements for key control system.
4) Requirements for access control.
5) Address for delivery of keys.

2. Pre-installation Conference

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.6 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.7 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

a. Mechanical Warranty

1) Locks

a) MORTISE LOCKS: 2 years
b) CYLINDRICAL LOCKS: 10 years

2) Exit Devices

a) PRECISION: 5 years

3) Closers

a) LCN 4000 Series: 30 years

b. Electrical Warranty

1) Locks

a) ELECTRIFIED LOCKS: 1 year

2) Exit Devices

a) ELECTRIFIED PANICS: 1 year

1.8 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 012500.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Ives 5BB series

2. Acceptable Manufacturers and Products:

    a. Hager BB1191/1279 series
    b. McKinney TB series
    c. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

    a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
    b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

    a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:

    a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
9. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

    a. Steel Hinges: Steel pins
    b. Non-Ferrous Hinges: Stainless steel pins
    c. Out-Swinging Exterior Doors: Non-removable pins
    d. Out-Swinging Interior Lockable Doors: Non-removable pins
    e. Interior Non-lockable Doors: Non-rising pins

10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.4 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

a. Rockwood
b. DCI
c. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.5 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Best 45H Series

2. Acceptable Manufacturers and Products:

a. No Substitute - Owner Standard

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
6. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

a. Provide levers that return to within 1/2 inch (13 mm) of door face.
b. Lever Design: AS Scheduled

2.6 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Best 9K Series

2. Acceptable Manufacturers and Products:

a. No Substitute - Owner Standard

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

a. Provide levers that return to within 1/2 inch (13 mm) of door face.
b. Lever Design: As Scheduled

2.7 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Precision Apex Series

2. Acceptable Manufacturers and Products:

a. No Substitute- Owner Standard

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.

12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

    a. Provide levers that return to within 1/2 inch (13 mm) of door face.

2.8 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:

   a. Best COREMAX

2. Acceptable Manufacturers and Products:

   a. No Substitute -Owner standard

B. Requirements:

1. Provide cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

2.9 KEYING

A. Scheduled System:

1. Existing factory registered system:

   a. Provide cylinders/cores keyed into Owner’s existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:

   a. Replaceable Construction Cores.

      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.

         a) 3 construction control keys
         b) 12 construction change (day) keys.

      2) Owner or Owner’s Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:

a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

c. Provide keys with the following features:

1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

d. Identification:

1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
2) Identification stamping provisions must be approved by the Architect and Owner.
3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.

1) Permanent Control Keys: 3.
2) Master Keys: 6.
3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
4) Key Blanks: Quantity as determined in the keying meeting.

2.10 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. LCN 4040XP series

2. Acceptable Manufacturers and Products:

a. Sargent 281 series
b. Dorma Kabba QDC100

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.

2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives

2. Acceptable Manufacturers:

   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:

   a. Glynn-Johnson

2. Acceptable Manufacturers:

a. Rixson
b. Sargent
c. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.13 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Trimco
b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:

a. Zero International

2. Acceptable Manufacturers:

a. National Guard
b. Reese
c. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.

2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.15 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Rockwood
b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.16 FINISHES

A. As Scheduled

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.

3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Abbreviation	Name
BES	Best Locking Systems
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	Lcn Commercial Division
PRE	Precision
ZER	Zero International Inc

103492 OPT0352374 Version 3

HW SET: 01

For use on Door #(s):

A107	A110	B100A	B104	B107	C102
C105					

Each to have:

4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
2	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	✓	630	IVE
1	EA	KEYED REMOVABLE MULLION	KR822 MCS		689	PRE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2102 X 1702A S301	✓	626AM	PRE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2103 X 1703A S301	✓	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	MORTISE CYLINDER	1E72 PATD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	MULLION SEAL	8780		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER.	PROVIDED BY OWNER	✓		
1	EA	ACCESS CONTROL EQUIP.	PROVIDED BY OWNER	✓		
1	EA	POWER SUPPLY	RPSMLR2	✓		PRE

OPERATION:
DOORS NOPRMALLY CLOSED AND SECURED
ENTRY BY CREDENTIAL READER TO RETRACT EXIT DEVICES, USER PULLS DOOR OPEN TO ENTER
EGRESS AT ALL TIMES BY EXIT DEVICES
AUTO LOCK / UNLOCK BY SCHEDULE

HW SET: 01A

For use on Door #(s):
C100A

Each to have:

4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
2	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	✓	630	IVE
1	EA	KEYED REMOVABLE MULLION	KR822 MCS		689	PRE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2102 X 1702A S301	✓	626AM	PRE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2103 X 1703A S301	✓	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	MORTISE CYLINDER	1E72 PATD		626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	SURF. AUTO OPERATOR	4642 CS TBWMS 120 VAC	✓	689	LCN
2	EA	WIRELESS ACTUATOR PKG	8310-3857TW	✓	630	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	MULLION SEAL	8780		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER.	PROVIDED BY OWNER	✓		
1	EA	ACCESS CONTROL EQUIP.	PROVIDED BY OWNER	✓		
1	EA	POWER SUPPLY	RPSMLR2	✓		PRE

OPERATION:
DOORS NOPRMALLY CLOSED AND SECURED
ENTRY BY CREDENTIAL READER TO RETRACT EXIT DEVICES, USER PULLS DOOR OPEN TO ENTER
EGRESS AT ALL TIMES BY EXIT DEVICES
AUTO LOCK / UNLOCK BY SCHEDULE
AUTOMATIC OPERATOR: INSIDE ACTUATOR ALWAYS ACTIVE AND WILL RETRACT THE LATCHBOLT AND CYCLE THE OPERATOR. EXTERIOR ACTUATOR ONLY ACTIVE WHEN DOORS ARE UNLOCKED.

HW SET: 02

For use on Door #(s):
C100B C100C

Each to have:

4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
2	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	↯	630	IVE
1	EA	KEYED REMOVABLE MULLION	KR822 MCS		689	PRE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2102 X 1702A S301	↯	626AM	PRE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2103 X 1703A S301	↯	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	MORTISE CYLINDER	1E72 PATD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	MULLION SEAL	8780		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	ACCESS CONTROL EQUIP.	PROVIDED BY OWNER	↯		
1	EA	POWER SUPPLY	RPSMLR2	↯		PRE

OPERATION:
AUTO LOCK / UNLOCK BY SCHEDULE
DOORS NOPRMALLY CLOSED AND SECURED
EGRESS AT ALL TIMES BY EXIT DEVICES

HW SET: 03

For use on Door #(s):
A106

Each to have:

2	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	↯	630	IVE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2103 X 1703A S301	↯	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER.	PROVIDED BY OWNER	↯		
1	EA	ACCESS CONTROL EQUIP.	PROVIDED BY OWNER	↯		
1	EA	POWER SUPPLY	RPSMLR2	↯		PRE

OPERATION:
DOOR NOPRMALLY CLOSED AND SECURED
ENTRY BY CREDENTIAL READER TO RETRACT EXIT DEVICE, USER PULLS DOOR OPEN TO ENTER
EGRESS AT ALL TIMES BY EXIT DEVICE

HW SET: 04

For use on Door #(s):
A108 A109 B105 B112 C103

Each to have:

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	KEYED REMOVABLE MULLION	KR822 MCS		689	PRE
1	EA	EXIT DEVICE	2102 X 1702A S301	↯	626AM	PRE
1	EA	EXIT DEVICE	2103 X 1703A S301	↯	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	MORTISE CYLINDER	1E72 PATD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA (@ DOORS WITH NO OVERHANG)		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	MULLION SEAL	8780		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

HW SET: 05 - Not Used

HW SET: 06

For use on Door #(s):
C104

Each to have:

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	KEYED REMOVABLE MULLION	KR822 MCS		689	PRE
1	EA	EXIT DEVICE	2102 X 1702A S301	✓	626AM	PRE
1	EA	EXIT DEVICE	2103 X 1703A S301	✓	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	MORTISE CYLINDER	1E72 PATD		626	BES
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S		BLK	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	MULLION SEAL	8780		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

HW SET: 07

For use on Door #(s):

A104A	A104B	B101	B102	B106	B108
B109	B111	C101	C107		

Each to have:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	EXIT DEVICE	2103 X 1703A S301	✓	626AM	PRE
1	EA	RIM CYLINDER	12E72 PATD		626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

HW SET: 08

For use on Door #(s):
B100B

Each to have:

2	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	↯	630	IVE
1	EA	ELECTRIFIED EXIT DEVICE	3RO MLR 2102 X 1702A S301	↯	626AM	PRE
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	ACCESS CONTROL EQUIP.	PROVIDED BY OWNER	↯		

OPERATION:
DOOR NORMALLY CLOSED AND SECURE
DOOR LOCKS / UNLOCKS ON SCHEDULE, WHEN UNLOCKED DOOR MAY BE PULLED OPEN FOR ENTRY
EGRESS AT ALL TIMES BY EXIT DEVICE

HW SET: 09

For use on Door #(s):
B103 B110 C106

Each to have:

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2	626	IVE
1	EA	STOREROOM W/ DB	45H-7-TD-15H PATD S3	626	BES
2	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	SECURITY ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HW SET: 10

For use on Door #(s):
308B

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCKSET	9K37D 15D PATD S3	626AM	BES
1	EA	SURFACE CLOSER	4040XP HEDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW SET: 11

For use on Door #(s):
(E)308 308E

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE LOCKSET	9K37UA 15D PATD S3	626AM	BES
1	EA	SURFACE CLOSER	4040XP HEDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW SET: 12

For use on Door #(s):
308C

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE LOCKSET	9K37UA 15D PATD S3	626AM	BES
1	EA	SURFACE CLOSER	4040XP HCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW SET: 13

For use on Door #(s):
308D

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE	9K30N 15D S3	626AM	BES
1	EA	SURFACE CLOSER	4040XP HEDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 14

For use on Door #(s):
111

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	KEYED PRIVACY W/ IND	45H-7-T-15H VIN PATD S3	626	BES
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

DOOR IS NORMALLY UNLOCKED AND INDICATOR IS GREEN FOR "VACANT"
USER ENTERS RESTROOM CLOSES DOOR AND ROTATED THUMBTURN EXTENDING THE DEAD BOLT AND CHANING THE OUTSIDE INDICATOR TO RED INDICATING "OCCUPIED"
USER ROTATES INSIDE LEVER SIMULTANIOUSLY RETRACTIGNG THE LATCHBOLT AND DEAD BOLT AND RETRUNING THE INDICATOR TO GREEN
EMERGENCY ENTRY WHEN OCCUPIED BY KEY.

HW SET: 15

For use on Door #(s):
(E)308A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/ IND	45H-0-L-15H VIN S3	626	BES
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

DOOR IS NORMALLY UNLOCKED AND INDICATOR IS GREEN FOR "VACANT"
USER ENTERS RESTROOM CLOSES DOOR AND ROTATED THUMBTURN EXTENDING THE DEAD BOLT AND CHANING THE OUTSIDE INDICATOR TO RED INDICATING "OCCUPIED"
USER ROTATES INSIDE LEVER SIMULTANIOUSLY RETRACTIGNG THE LATCHBOLT AND DEAD BOLT AND RETRUNING THE INDICATOR TO GREEN
EMERGENCY ENTRY WHEN OCCUPIED BY KEY.

HW SET: 16

For use on Door #(s):
A105

Each to have:

5	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	↯	630	IVE
1	EA	ELECTRIFIED LOCK	9KW 37DEU 15D PATD S3		626AM	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	SET	GASKETING	429AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER.	PROVIDED BY OWNER	↯		
1	EA	ACCESS CONTROL EQUIP.	PROVIDED BY OWNER	↯		

FIELD VERIFY EXISTING CONDITIONS

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Storefront framing.
4. Glazed entrances.
5. Fire-resistance-rated glazing assemblies.

B. Related Sections:

1. Section 081113 – “Hollow Metal Doors and Frames.”
2. Section 081416 – “Flush Wood Doors” for Vision Lites.
3. Section 084113 – “Aluminum-framed entrances and storefronts.”

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Structural Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.4 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.6 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

C. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal.
2. Spacer: Manufacturer's standard spacer material and construction.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 INSULATING-GLASS – VISON GLAZING

A. Basis-of-Design Product: Provide Solexia Solarban 60 (2) Low-E Glass as manufactured by PPG Industries, or comparable products with equivalent or better performance characteristics, by one of the following:

1. Pilkington North America
2. Guardian Industries.
3. Viracon.

B. Glass Type **GL-1**:

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Solexia Solarban 60 (2), green-tinted float glass, or approved equal. Provide fully tempered float glass where indicated on Drawings.
4. Interspace Content: Air.
5. Indoor Lite: Clear float glass. Provide fully tempered float glass where indicated on Drawings.
6. Low-E Coating: Pyrolytic or sputtered on second surface.
7. Visible Light Transmittance: greater than or equal to 50 percent.
8. Winter Nighttime U-Factor: 0.29 maximum.

9. Summer Daytime U-Factor: 0.27 maximum.
10. Solar Heat Gain Coefficient: 0.30 maximum.
11. Provide safety glazing labeling.

2.8 CLEAR VISION GLASS **GL-3**

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

1. Minimum Thickness: 6 mm.
2. Provide fully-tempered float glass where safety glazing is indicated.

2.9 FIRE-RESISTANCE-RATED GLAZING

A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.

C. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.

1. Products: Subject to compliance with requirements, provide one of the following:

a. AGC Glass Company North America, Inc.; Pyrobel.
b. Pilkington North America; Pyrostop.
c. SAFTI FIRST Fire Rated Glazing Solutions; SuperLite II-XLM 120.
d. Technical Glass Products; Pyrostop.
e. Vetrotech Saint-Gobain; SGG Contraflam.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants determined by preconstruction sealant and substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.3 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

B. Related Sections include the following:

1. Division 07 Section "Building Insulation" for insulation installed in assemblies that incorporate gypsum board.
2. Division 09 Section "Non-Structural Metal Framing" for non-structural framing that support gypsum board.
3. Section 093013, “Ceramic Tiling” for joint sealants for sealing of expansion, contraction, control, and isolation joints in tile surfaces; glass mat, water-resistant backer board and cementitious backer units.
4. Section 099123, “Interior Painting” for primers and coatings applied to gypsum board surfaces.
5. Division 22, 22, 23, 26, 27 and 28 Sections for mechanical, plumbing and electrical items installed in gypsum-sheathed assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles, bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Gypsum Co.
b. BPB America Inc.
c. G-P Gypsum.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Temple.

h. USG Corporation.

B. Type X:

1. Thickness: 5/8-inch and 1/4-inch.
2. Long Edges: Tapered.

C. High-Impact Type:

1. Manufactured with fire-resistive core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance). Manufacturer: National Gypsum Company; Product: “Hi-Impact Brand Wallboard.”

   a. Core: 5/8 inch thick.
   b. Plastic-Film Thickness: 0.010 inch0.020 inch.

2. Manufactured with reinforcing fiber mesh in fire-resistive core, and no paper face for greater resistance to through-penetration (impact resistance). Manufacturer: USG Corporation; Product: “Fiberock "VHI" Abuse-Resistant Panels.”

   a. Core: 5/8 inch thick.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   d. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.

4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

    a. Basis-of-Design Product: Manufacturer: USG Corporation; Product: Sheetrock Brand, Primer-Surfacer, or an equivalent product by another manufacturer with prior written approval of Architect.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: As specified in Division 7 Section “Building Insulation.”

E. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."

F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Install expansion (control) joints with space between edges of adjoining gypsum panels as follows (coordinate location with Architect where location is arbitrary):

1. In partitions, walls, and ceilings that traverse an expansion, seismic, or control joint in the structural system.
2. Where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear ft. (9100 mm).
3. In interior ceilings with perimeter relief, so that linear dimensions between control joints do not exceed 50 ft. (15000 mm), and total area between control joints does not exceed 2500 sq. ft. (230 sq. m).
4. In interior ceilings without perimeter relief, so than linear dimensions between control joints do not exceed 30 ft. (9100 m), and total area between control joints does not exceed 900 sq. ft. (84 sq. m).
5. In exterior ceilings and soffits, so that linear dimensions between control joints do not exceed 30 ft. (9100 m), and total area between control joints does not exceed 900 sq. ft. (84 sq. m).
6. Where ceiling framing members change direction. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Walls with sound Attenuation Blanket Insulations: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type X: Install on all wall surfaces not normally exposed to students (offices, storage rooms, electrical rooms, etc.) and framed soffits and ceilings, unless indicated otherwise on Drawings.
2. High-Impact Type: Install on all wall surfaces normally exposed to students (hallways classrooms, labs, shops) and where indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.

    a. Fastening Methods: Apply gypsum panels to supports with steel drill screws spaced at 12-inches (305 mm) on center, unless requirements for fire-resistance ratings indicate otherwise.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
    c. Fastening Methods: Apply gypsum panels to supports with steel drill screws, with the following spacing:

        1) Fasten to framing spaced at 16-inches (400 mm) on center with screws spaced at 16-inches (400 mm) on center, unless requirements for fire-resistance ratings indicate otherwise.
        2) Fasten to framing spaced at 24-inches (610 mm) on center with screws spaced at 12-inches (305 mm) on center, unless requirements for fire-resistance ratings indicate otherwise.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints with space between edges of adjoining gypsum panels as follows, and where indicated on Drawings (coordinate location with Architect where location is arbitrary):

1. In partitions, walls, and ceilings that traverse an expansion, seismic, or control joint in the structural system.
2. Where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear ft. (9100 mm).
3. In interior ceilings with perimeter relief, so that linear dimensions between control joints do not exceed 50 ft. (15000 mm), and total area between control joints does not exceed 2500 sq. ft. (230 sq. m).
4. In interior ceilings without perimeter relief, so than linear dimensions between control joints do not exceed 30 ft. (9100 m), and total area between control joints does not exceed 900 sq. ft. (84 sq. m).

5. Where ceiling framing members change direction.

C. Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. Curved-Edge Cornerbead: Use at curved openings.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 5: At panels that will be exposed to view, unless otherwise indicated.

a. Use high-build, spray-applied coating.

E. Cementitious Backer Units: Finish according to manufacturer’s written instructions.

3.6 PROTECTION

A. Paper-Surfaced Gypsum Sheathing: Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing paper securely fastened to framing. Apply covering immediately after sheathing is installed.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Tile backing panels.
3. Waterproof membrane for thinset applications.
4. Metal edge strips.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Face Size: Actual tile size, excluding spacer lugs.

D. Module Size: Actual tile size plus joint width indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

1. Each type and composition of tile and for each color and finish required.
2. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For ceramic tile and gauged porcelain tile panels to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain waterproof membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Waterproof membrane.
2. Cementitious backer units.
3. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.3 TILE PRODUCTS

A. Porcelain Floor Tile **PFT-1**

1. Basis of Design: Subject to compliance with requirements, provide **Tilebar**; “Color Story Floor” or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

   a. American Olean
   b. Marazzi
   c. Daltile

2. Composition: Colorbody Porcelain.
3. Module Size: **24 inches x 48 inches**
4. Thickness: **10 mm**
5. Dynamic Coefficient of Friction: Not less than 0.42.
6. Finish: Unpolished
7. Tile Color: **Kobe Cement Smoke Gray 24x48 terrazo look**
8. Grout Color: **Mapei Cobblestone 103**
9. Grout Width: 3/16 inches
10. Pattern: As indicated on drawings.

B. Ceramic Floor Tile **CFT-1**

1. Basis of Design: Subject to compliance with requirements, provide American Olean; “Color Story Mosaics” tile or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

   a. Crossville
   b. Marazzi
   c. Daltile

2. Composition: Ceramic.
3. Module Size: 1 inches x 1 inches
4. Thickness: 1/4 inches.
5. Dynamic Coefficient of Friction: Not less than 0.42.

6. Finish: Unpolished
7. Tile Color:

    a. Matte Balance 0034
    b. Ice White 0025
    c. Wisdom 0082
8. Grout Color: **Mapei Avalanche 38**
9. Grout Width: 1/8 inches
10. Pattern: DP2036 per Manufacturer's Standard 1 x 1 modules.

    a. Color A: 50%
    b. Color B: 6%
    c. Color C: 44%

C. Ceramic Wall Tile **CWT-1**

1. Basis of Design: Subject to compliance with requirements, provide American Olean; "Color Story Wall" or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

    a. Crossville
    b. Marazzi
    c. Daltile

2. Composition: Ceramic
3. Module Size: 4 inches by 16 inches
4. Thickness: 3/8 inches.
5. Finish: Glazed.
6. Tile Color: **Ice White 0025**
7. Grout Color: **Mapei Avalanche 38**
8. Grout Width: 1/16 inches
9. Pattern: As indicated on drawings.

D. Ceramic Wall Tile **CWT-2**

1. Basis of Design: Subject to compliance with requirements, provide American Olean; "Color Story Wall" or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

    a. Crossville
    b. Marazzi
    c. Daltile

2. Composition: Ceramic
3. Module Size: 4 inches by 12 inches
4. Thickness: 5/16 inches.
5. Finish: Glazed.
6. Tile Color: **Green Apple 0076**
7. Grout Color: **Mapei Avalanche 38** .
8. Grout Width: 1/16 inches
9. Pattern: As indicated on drawings.

E. Ceramic Wall Tile **CWT-3**

1. Basis of Design: Subject to compliance with requirements, provide American Olean; “Color Story Wall” or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

    a. Crossville
    b. Marazzi
    c. Daltile

2. Composition: Ceramic
3. Module Size: 4 inches by 12 inches
4. Thickness: 5/16 inches.
5. Finish: Glazed.
6. Tile Color: **Wisdom 0082**
7. Grout Color: **Mapei Avalanche 38**
8. Grout Width: 1/16 inches
9. Pattern: As indicated on drawings.

F. Ceramic Wall Tile **CWT-4**

1. Basis of Design: Subject to compliance with requirements, provide American Olean; “Color Story Wall” or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

    a. Crossville
    b. Marazzi
    c. Daltile

2. Composition: Ceramic
3. Module Size: 4 inches by 12 inches
4. Thickness: 5/16 inches.
5. Finish: Glazed.
6. Tile Color: **Scalet 0010**
7. Grout Color: **Mapei Avalanche 38**
8. Grout Width: 1/16 inches
9. Pattern: As indicated on drawings.

G. Ceramic Wall Tile **CWT-5**

1. Basis of Design: Subject to compliance with requirements, provide American Olean; “Color Story Wall” or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

    a. Crossville
    b. Marazzi
    c. Daltile

2. Composition: Ceramic
3. Module Size: 4 inches by 12 inches
4. Thickness: 5/16 inches.
5. Finish: Glazed.
6. Tile Color: Black Rectangle 0049
7. Grout Color: **Mapei Avalanche 38**
8. Grout Width: 1/16 inches
9. Pattern: As indicated on drawings.

2.4 THRESHOLDS/TRANSITIONS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Description: Metal Cove Base –Floor Tile to Wall Tile - **MCB-1**

1. Basis-of-Design Product: “DILEX-AHK”, as manufactured by Schluter Systems, or comparable product only with written approval of Architect in an addendum published prior to Bidding.
2. Material: Satin Anodized Aluminum (AE).
3. Height of product to be determined by tile subcontractor, depending on height of tile and thinset application. Tile subcontractor to supply connectors, end caps, and outside corner squares.

C. Description: Metal Transition –Floor Tile to Luxury Vinyl Tile - **MCB-2**

1. Basis-of-Design Product: “SCHIENE”, as manufactured by Schluter Systems, or comparable product only with written approval of Architect in an addendum published prior to Bidding.
2. Material: Satin Anodized Aluminum (AE).
3. Tile subcontractor to supply connectors, end caps, and outside corner squares.

D. Description: Metal Transition – Floor Tile to Sheet Vinyl or VCT - **MCB-3**

1. Basis-of-Design Product: “RENO-U”, as manufactured by Schluter Systems, or comparable product only with written approval of Architect in an addendum published prior to Bidding.
2. Material: Satin Anodized Aluminum (AE).
3. Tile subcontractor to supply connectors, end caps, and outside corner squares.

E. Description: Metal Transition - Metal Edge Protection–Outside corners of tiled surfaces on walls

1. Basis-of-Design Product: “JOLLY”, as manufactured by Schluter Systems, or comparable product only with written approval of Architect in an addendum published prior to Bidding.
2. Material: Satin Anodized Aluminum (AE).
3. Tile subcontractor to supply connectors, end caps, and outside corner squares.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

1. Products: Subject to compliance with requirements, provide Schluter Systems L.P; KERDI.

2.6 SETTING MATERIALS

A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARDEX Americas.
b. Bostik Inc.
c. Custom Building Products.
d. H.B. Fuller Construction Products Inc. / TEC.
e. Laticrete Supercap, LLC.
f. MAPEI Corporation.
g. Schluter Systems, LLC.

2. For wall applications, provide mortar that complies with requirements for no sagging mortar in addition to the other requirements in ANSI A118.1, and ANSI A108.19 for gauged porcelain tile panels.

2.7 GROUT MATERIALS

A. Water-Cleanable, Epoxy Grout: ANSI A118.3. Architect to choose from Manufacturer’s full range of product. Basis of Design is provided above.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.
b. Custom Building Products.
c. H.B. Fuller Construction Products Inc. / TEC.
d. LATICRETE SUPERCAP, LLC.
e. MAPEI Corporation.

2.8 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. CertainTeed; SAINT-GOBAIN.
b. Georgia-Pacific Gypsum LLC.
c. Gold Bond Building Products, LLC provided by National Gypsum Company.
d. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. C-Cure.
   b. CertainTeed; SAINT-GOBAIN.
   c. PermaBASE Building Products, LLC provided by National Gypsum Company.
   d. USG Corporation.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Gypsum.
   b. CertainTeed; SAINT-GOBAIN.
   c. Georgia-Pacific Gypsum LLC.
   d. Panel Rey.
   e. USG Corporation.

2. Core: 5/8 inch, Type X.

2.9 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.

2.10 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.
B. Joint Tape:

1. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.11 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CERAMIC TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

a. Tile floors and walls in wet areas.
b. Tile floors consisting of tiles 8 by 8 inches or larger if possible.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Use specified Schluter trim shapes as discussed in 2.4 where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile as specified on drawings. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Refer to TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" and to the ANSI A108 series of tile installation standards for data on expansion joints. These standards require that joint locations be indicated on Drawings.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

H. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.3 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.4 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.5 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Porcelain and Ceramic Tile Installation: TCNA F113; thinset mortar.

a. Ceramic Tile Type: **PFT-1, CFT-1a-c.**
b. Thinset Mortar: Standard dry-set mortar.
c. Grout: Water-cleanable epoxy grout.

2. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.

a. Ceramic Tile Type: **CWT-1-5**
b. Thinset Mortar: Modified dry-set mortar.
c. Grout: High-performance Water-cleanable epoxy grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Related Sections include the following:

1. Division 05 Sections for structural support for ceiling suspension systems.
2. Division 07 Section "Building Insulation" for sound attenuation blanket insulation.
3. Division 07 Section "Joint Sealants" for acoustical sealants.
4. Division 21, 22, 23, 26 and 27 Sections for fixtures installed in acoustical panel ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

3. Ceiling-mounted items including, but not limited to, smoke detectors, lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/8 inch = 1 foot.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

E. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

F. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class B materials as determined by testing identical products per ASTM E 84:

a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with

requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING **APC-1**

A. Basis-of-Design Product: Armstrong Ceilings Product: “Fine Fissured” #1757”, or a comparable product by one of the following manufacturers, with prior written approval of Architect:

1. BPB USA.
2. USG.
3. CertainTeed Corporation.

B. Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. Additional construction costs required for the incorporation of a comparable product into the Work shall be the responsibility of the Contractor.

C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
2. Pattern: CE (perforated, small holes and light textured).

D. Color: White.

E. LR: Not less than 0.84.

F. NRC: Not less than 0.75.

G. CAC: Not less than 35.

H. Edge/Joint Detail: Square.

I. Thickness: 5/8 inch.

J. Modular Size: 24 by 48 inches.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING **APC-2**

A. Basis-of-Design Product: Armstrong Ceilings Product: #605 “Ceramaguard”, or comparable product by one of the following manufacturers, with prior written approval of Architect:

1. BPB USA.
2. USG.
3. CertainTeed Corporation: SAINT-GOBAIN

B. Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. Additional construction costs required for the incorporation of a comparable product into the Work shall be the responsibility of the Contractor.

C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type XX, high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes
2. Pattern: G (smooth).

D. Color: White.

E. LR: Not less than 0.85.

F. CAC: Not less than 40.

G. Edge/Joint Detail: Square.

H. Thickness: 5/8 inch.

I. Modular Size: 24 by 48 inches

J. Antimicrobial treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING **APC-3**

A. Basis-of-Design Product: Armstrong Ceilings Product: Lyra Vector ”, or a comparable product by one of the following manufacturers, with prior written approval of Architect:

1. BPB USA.
2. USG.

3. CertainTeed Corporation.

B. Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. Additional construction costs required for the incorporation of a comparable product into the Work shall be the responsibility of the Contractor.

C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.

D. Color:

1. C-1: PACIFIC (SPC)
2. C-2: RAINSTORM (SRS)
3. C-3: LILAC (SLC)
4. C-4: TWILIGHT (STT)
5. C-5: FERN (SFN)
6. C-6: IVY (SIV)
7. C-7: MARIGOLD (SMG)
8. C-8: ROSE (SRO)

E. LR: Not less than 0.84.

F. NRC: Not less than 0.75.

G. CAC: Not less than 35.

H. Edge/Joint Detail: Square.

I. Thickness: 5/8 inch.

J. Modular Size: 24 by 48 inches.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

E. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

H. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

I. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING (APC-1, APC-2 & APC-3)

A. Basis-of Design Product: Manufacturer: **Armstrong World Industries Inc.; 15/16" (24 mm) "Prelude XL"** or a comparable product by one of the following manufacturers, with prior written approval of Architect:

1. BPB USA.
2. Chicago Metallic Corporation.
3. **USG Interiors, Inc**

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: **To match color of specific ceiling tile color, see APC-3.**

2.7 METAL EDGE MOLDINGS AND TRIM (APC-1 & APC-2)

A. Provide metal edge moldings and trim by the same manufacturer as the metal suspension system.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
4. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum.

2.8 METAL EDGE MOLDINGS AND TRIM (APC-3)

A. Provide metal edge moldings and trim, basis of design Axiom Vector Curved Perimeter Trim by Armstrong.

1. Basis of Design: Armstrong’s AXIOM for INTERLUDE 2” edge moldings that fit acoustical panel edge details and suspension systems.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. Color: **White**

2.9 ACOUSTICAL SEALANT

A. As specified in Division 7 Section “Joint Sealants.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.
10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Resilient wall base.
2. Resilient molding accessories.

B. Related Sections include the following:

1. Division 01 Section "Quality Requirements” for requirements for testing Agency.
2. Division 03 Section “Cast-In-Place Concrete" for substrate for resilient accessories.
3. Division 09 Section “Gypsum Board” for substrate for resilient wall base.
4. Division 09 Flooring Sections for flooring requiring resilient wall base and accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

D. Test Reports:

1. Submit reports for substrate alkalinity, adhesion, and moisture tests, indicating that conditions of concrete slab conforms to requirements of resilient base manufacturer.
2. Submit prior to beginning resilient base installation.

1.4 QUALITY ASSURANCE

A. Substrate (alkalinity, adhesion, and moisture) Testing Entity: Owners testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, equivalent products to those specified may be incorporated into the Work with prior written approval of Architect.

2.2 RESILIENT WALL BASE - ASTM F 1861.

A. **RWB-1**.

1. Basis of Design Product: Manufacturer: Tarkett; Product: “Duracove” Rubber Wall Base; Color: as selected by Architect from Manufacturer’s full range, or a matching product by one of the following manufacturers:

a. Armstrong World Industries, Inc.
b. Burke Mercer Flooring Products.
c. Roppe Corporation.

2. Characteristics:

a. Type (Material Requirement): TP (rubber, thermoplastic).
b. Group (Manufacturing Method): I (solid).
c. Style: A.
d. Height: 4 inches
e. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
f. Outside Corners: Job formed.
g. Inside Corners: Job formed.
h. Surface: Smooth.

2.3 RESILIENT MOLDING ACCESSORY **RMA-1**

A. Description: Adaptor: Carpet to VCT.

1. Basis-of-Design Products; #SLT-XX-A, color; to be selected from Manufacturer’s full range, or a comparable product by one of the manufacturers listed above.

B. Material: Rubber.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Cove Base Adhesives: 50 g/L.
b. Rubber Floor Adhesives: 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Proceed with installation only after substrates pass tests and all unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Job-Formed Corners:

1. Outside Corners:

a. Job-form corners from straight pieces of maximum lengths where returns are 3-inches in length or longer. Form without producing discoloration (whitening) at bends.
b. Use Preformed Corners where returns are less than 3-Inches.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3-inches in length.

a. Miter or cope corners in minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Section 033000 “Cast in place Concrete” for floor slab finishing and flatness tolerances.
2. Section 096513 “Resilient Base and Accessories” for resilient base and reducer strips.
3. Other Division 09 “Flooring…” Sections for adjacent floor finishes.

1.2 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and pattern specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Tile Flooring: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

B. Pre-installation Conference: Conduct conference with Installer, Architect, Interior Designer, and Contractor prior to installation at Project Site.

1.7 DELIVERY, STORAGE AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 90 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.9 WARRANTY

A. Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the product’s warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE **LVT-1**

A. Basis of Design: Subject to compliance with requirements, provide Interface; “Brushed Lines,” or a comparable product by one of the following, only with prior written approval of Architect in an Addendum published prior to Bidding:

1. Shaw Contract.
2. Mohawk Group.

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.

C. Thickness: 4.5 mm

1. Wear Layer: 22 mil.

D. Size: 25 cm x 1 m (9.845 inches by 39.38 inches).

E. Finish: Ceramor.

F. Colors and Patterns:

1. A (75%): Galena
2. B (25%): Alabaster

G. Installation: Ashlar with colors A and B to be randomly distributed in a 75% to 25% ratio, respectively.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives must contain low emitting, <50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9] pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform one test in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 85% in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile

installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Do not use plastic adhesive based protection system.

END OF SECTION 096519

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SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Modular carpet tile and installation accessories.

B. Related Requirements:

1. Section 033000 “Cast in Place Concrete”
2. Section 096513 "Resilient Base and Accessories"
3. Section 096519 "Resilient Tile Flooring"

1.3 ACTION SUBMITTALS

A. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.

B. Installation Plan Drawing. Provide drawing of each level showing pattern of carpet tiles, including designation indicated on Drawings and in schedules.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.8 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

    a. More than 10 percent edge raveling, snags, and runs.
    b. Dimensional instability.
    c. Excess static discharge.
    d. Loss of tuft-bind strength.
    e. Loss of face fiber.
    f. Delamination.
    g. Color Pattern Permanency
    h. Cushion Resiliency
    i. Moisture Resistance
    j. Staining/Soiling
    k. Edge Ravel
    l. Flammability

3. Warranty Period: Limited Lifetime

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis of Design Carpet Tile **CPT-1 (Robert Stuart):** Subject to compliance with requirements, provide products by Mohawk Group, “Smart City” collection.

1. **Color: Green Line 946**
2. **Style: Urban Mobility GT430**
3. Fiber Content: Duracolor Tricor Premium Nylon.
4. Pile Characteristic: Textured Patterned Loop.
5. Dye Method: Solution Dyed.
6. Primary Backing: EcoFlex NXT.
7. Size: 12 inches by 36 inches.
8. Installation Method: Brick Ashlar.
9. Applied Treatments: Soil-Resistance Treatment: Manufacturer's standard treatment.

B. Basis of Design Carpet Tile **CPT-2 (O’Leary):** Subject to compliance with requirements, provide products by Mohawk Group, “Learn and Live” collection.

1. **Color: Heritage**
2. **Style: Side Stripe GT419**
3. Fiber Content: Duracolor Tricor Premium Nylon.
4. Pile Characteristic: Textured Patterned Loop.
5. Dye Method: Solution Dyed.
6. Primary Backing: EcoFlex NXT.
7. Size: 24 inches by 24 inches.
8. Installation Method: Brick Ashlar.
9. Applied Treatments: Soil-Resistance Treatment: Manufacturer's standard treatment.

C. Basis of Design Walk-off Mat, **WM-1:** Subject to compliance with requirements, provide products by J & J Flooring Group, “Catwalk II Walk-off Modular” Collection.

1. Color: “Spotlight” 1427
2. Pattern: “Catwalk II“ 7268
3. Fiber Content: Encore SD (with recycled content)
4. Pile Characteristic: Textured Loop
5. Dye Method: Solution Dyed
6. Density: 6,607 oz./y^3
7. Stitches: 9.0 stitches/inch
8. Total Weight: 34 oz/yard^3
9. Primary Backing: Nexus Modular
10. Total Thickness: 0.375 inches
11. Size: 24” x 24”
12. Installation Method: Quarter Turn

D. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.

E. Sustainable Design Requirements:

1. Indoor Air Quality – CRI Green Label Plus

F. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.
3. Flammability: Passes Methenamine Pill Test according to CPSC-FFI-70.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

1. Self-Drying, Trowelable Concrete Underlayment : (At locations requiring concrete slab preparation and slope under Walk-off-Mats.)
2. Product: Ardex SD-P or equal, acceptable to Walk-off Mat Manufacturer

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft.,and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer and in pattern indicated on drawings.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders unless noted otherwise.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Gypsum board.
2. Acoustic ceiling tile.

B. Related Sections include the following:

1. Division 08 Sections for factory priming windows and doors with primers compatible with finish coats specified in this Section.
2. Section 092900 “Gypsum Board” for near Level 5, high-build, spray-applied coating for walls.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit 2 paper “draw-down” samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.
5. Where sheen is specified, submit samples in only that sheen.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, materials safety data sheet (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design; Sherwin Williams Company.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. Columbia Paint & Coatings.
3. Kelly-Moore Paints.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system, including but not limited to block fillers; primers/sealers for gypsum board and acoustic ceiling tiles; and metal primers, that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
4. Restricted Components: Paints and coatings shall not contain any of the following:

    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.
    k. Diethyl phthalate.
    l. Dimethyl phthalate.
    m. Ethylbenzene.
    n. Formaldehyde.
    o. Hexavalent chromium.
    p. Isophorone.
    q. Lead.
    r. Mercury.
    s. Methyl ethyl ketone.
    t. Methyl isobutyl ketone.
    u. Methylene chloride.
    v. Naphthalene.
    w. Toluene (methylbenzene).
    x. 1,1,1-trichloroethane.
    y. Vinyl chloride.

C. Interior Paint Colors - **P-#**:

    a. **P-1** (General Paint Color): Match Sherwin Williams color #SW7005 “Pure White,” Finish: See Schedule.
    b. P-4 (Accent @ O’LEARY): To be SHERWIN WILLIAMS RAVE RED 6608. Finish: See Schedule.
    c. P-5 (Accent @ O’LEARY): To be SHERWIN WILLIAMS SILVER PLATE 7649. Finish: See Schedule.
    d. P-6 (Accent @ ROBERT STUART): To be SHERWIN WILLIAMS OFFBEAT GREEN 6706. Finish: See Schedule.

e. **P-9** (Ceilings and Beams): Match Sherwin Williams color SW7757 “High Reflective White,” Finish:
f. **P-10** (Accent): Match Sherwin Williams color #SW6258 “Tricorn Black,” Finish: See Schedule.
g. **P-11** (Existing): Match Existing Paint based on Substrate. Finish: See Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply gypsum board primer/sealer to all gypsum wallboard surfaces indicated to receive wallcoverings.

E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner may engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System:.

a. Prime Coat: Interior/exterior latex block filler.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (low sheen).

B. Steel Substrates:

1. Other Exposed Metal - Waterborne Light Industrial Coating System:

a. Prime Coat: Where intermediate/topcoat are not self-priming, use Rust-Inhibitive primer (water based).
b. Intermediate Coat: Waterborne Light Industrial Coating matching topcoat.
c. Topcoat: Waterborne Light Industrial Coating (semigloss).

C. Gypsum Board Substrates (Ceilings):

1. Latex System:

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (flat)

D. Gypsum Board Substrates (Walls – Dry Areas):

1. Latex System:

a. Prime Coat: High-build near Level 5 primer/sealer Per Division 9 Section "Gypsum Board."
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior alkyd (eggshell).

E. Gypsum Board Substrates (Walls – Wet Areas):

1. Latex System:

    a. Prime Coat: High-build near Level 5 primer/sealer Per Division 9 Section "Gypsum Board."
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior high-performance coating alkyd (semi gloss).

F. Acoustic Tile Ceilings:

1. Acoustic ProCoat System:

    a. Grid Cleaning Solution: ProCoat Grid Cleaning Solution.
    b. Acoustical Tile Cleaner: ProCoat Acoustical Tile and Ceiling Cleaner.
    c. Prime Coat: High-build near Level 5 primer/sealer Per Division 9 Section "Gypsum Board."

        1) Apply only to ceiling tiles with water stains.

    d. Intermediate Coat: ProCoat Procoustic matching topcoat.
    e. Topcoat: ProCoat ProCoustic on acoustical ceiling tiles and exposed suspension grid system.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Exterior Steel Substrates, including, but not limited to:

a. Exposed steel lintels, miscellaneous exterior steel items.

B. Related Requirements:

1. Division 05 Sections for coordinating shop priming of metal substrates with primers that are compatible to the high performance coating specified in this Section.
2. Division 09 Section “Interior Painting” for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

A. Gloss Level 5: 35 to units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 qt. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.
2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

1.9 Warranty

A. Manufacturer’s standard warranty against weathering, specifically peeling, blistering, and significant ultraviolet discoloration under normal environmental conditions.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].

C. Color: As selected by Architect from manufacturer’s full range.

2.3 POLYURETHANE –ACRYLATE COATINGS

A. Polyurethane - Acrylate, Pigmented, Semi-Gloss (Gloss Level 5):

1. AquaSurTech: ATS D-45, or pre-approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:

1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Polyurethane-Acrylate, Pigmented:

a. Prime Coat: Not required on clean, properly-prepared metal substrates.
b. Intermediate Coat: Polyurethane-Acrylate, Semi-gloss (Gloss Level 5), at a minimum dry film thickness of 3.0-mils (0.007mm) per coat.
c. Topcoat: Polyurethane-Acrylate, Semi-gloss (Gloss Level 5), at a minimum dry film thickness of 3.0-mils (0.007mm) per coat.

END OF SECTION 099600

SECTION 101423 – INTERIOR PANEL SIGNAGE

PART 1 - GENERAL

1. RELATED DOCUMENTS

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

1. SUMMARY

C. Section Includes:

1. Room-identification and building code signs.

D. Related Requirements:

1. DEFINITIONS

E. Accessible: In accordance with the accessibility standard.

1. COORDINATION

F. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1. ACTION SUBMITTALS

G. Product Data: For each type of product.

H. Match Existing: Panel Signage must match the existing signage.

I. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

J. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

K. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample.
2. Room-Identification Signs: Full-size Sample.
3. Variable Component Materials: 8-inch Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.

L. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1. INFORMATIONAL SUBMITTALS

M. Qualification Data: For Installer and manufacturer.

N. Sample Warranty: For special warranty.

1. CLOSEOUT SUBMITTALS

O. Maintenance Data: For signs to include in maintenance manuals.

1. QUALITY ASSURANCE

P. Installer Qualifications: Manufacturer of products or entity that employs installers and supervisors who are trained and approved in writing by manufacturer.

1. FIELD CONDITIONS

Q. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. WARRANTY

R. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 ROOM IDENTIFICATION AND BUILDING CODE SIGNS

A. Provide panel signs with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **signs to match existing** as manufactured by one of the following:

a. Ace Sign Systems, Inc.
b. Best Sign Systems
c. Advance Corporation; Braille-Tac Division.
d. Allen Industries, Inc.
e. Allen Markings International.
f. APCO Graphics, Inc.
g. ASE, Inc.
h. ASI Sign Systems, Inc.
i. Bunting Graphics, Inc.
j. Clarke Systems.
k. Diskey Sign Company.
l. Fossil Industries, Inc.
m. InPro Corporation.
n. Mohawk Sign Systems.
o. Nelson-Harkins Industries.
p. Poblocki Sign Company, LLC.
q. Seton Identification Products.
r. Supersine Company (The); Division of Stamp-Rite, Inc.
s. Vista System.
t. Vomar Products, Inc.

B. Room Identification Signs and Code Signs – General:

1. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic or phenolic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: 0.125 inch.
b. Font Style: Match Existing
c. Color(s): Match Existing.
d. Provide 0.0625 inch acrylic backer plate to protect the graphic image.

2. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: Square cut.
b. Corner Condition in Elevation: Square.

3. Mounting: Surface mounted to wall with countersunk flathead through fasteners or surface-mounted to glass with two-face tape.
4. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color, and matching existing panel signage.

C. Room Identification Sign Types:

1. Sign Type A:

a. Sign Size: 7-inches wide x 5-inches high.
b. Message Panel Finish/Color: match existing.
c. Background Finish/Color: match existing.
d. Upper panel character size: 2-inches.
e. Lower panel character size: 5/8-inches.
f. Upper panel: Room number per schedule and Braille.
g. Lower panel: Room name per schedule and Braille.
h. Location: As directed by Architect.

2. Sign Type B: NOT USED
3.
4. Sign Type C: NOT USED
5.
6. Sign Type D: NOT USED
7.
8. Sign Type E:

a. Sign Size: 7-inches wide x 6-inches high.
b. Message Panel Finish/Color: match existing.
c. Background Finish/Color: match existing.
d. Character size: 5/8-inches.
e. Copy: As indicated on sign Schedule.
f. Provide two horizontal insert slots for changeable copy and Braille at bottom.
g. Location: As directed by Architect.
h.

9. Sign Type F:

a. Sign Size: 7-inches wide x 3-inches high.
b. Message Panel Finish/Color: 194 Pearl Gray (match existing).
c. Background Finish/Color: Matte, 574 Red (match existing).
d. Panel character size: 5/8-inches.
e. Panel copy: As indicated on sign schedule.
f. Location: As directed by Architect.

10. Sign Type G:

a. Sign Size: 8-inches wide x 8-inches high.
b. Message Panel Finish/Color: match existing.
c. Background Finish/Color: match existing.
d. Upper panel: Male and Female symbol and international symbol of accessibility
e. Lower panel character size: 5/8-inches.
f. Lower panel Copy: “RESTROOM”
g. Location: As directed by Architect.
h.

2.3 PANEL-SIGN MATERIALS

A. Plaque Material: Melamine plastic laminate, approximately 1/8" thick with contrasting core color. The melamine shall be non-static, fire-retardant and self-extinguishing. The plastic laminate will be impervious to most acids, alkalis, alcohol, solvents, abrasives and boiling water.

1. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Sign Mounting Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following.

1. Through-Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. For interior exposure, furnish stainless steel or hot-dip galvanized devices unless indicated otherwise.
4. Exposed Metal-Fastener Components, General:

    a. Fastener Heads: For nonstructural connections, use oval countersunk screws and bolts with tamper-resistant Allen-head or spanner-head screws unless otherwise indicated. Use exposed fasteners that match sign finish.

5. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Engraved copy in "Surface-Engraved Graphics" Paragraph below does not leave raised text.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.

1. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

1. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
2. Verify that anchor inserts are correctly sized and located to accommodate signs.
3. Verify that electrical service is correctly sized and located to accommodate signs.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls or horizontal sidelight rails as indicated and according to accessibility standard.

C. Mounting Methods:

1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 ROOM IDENTIFICATION/CODE SIGN SCHEDULE

A.	Door Number	C.	Sign Location	E. Sign Copy	F.	G.	Graphic Symbol	H.	Sign Type per Section 2.2.C
I.	100a	J.	100	K. #### L. ADMINISTRATION	M.	N.	-	O.	A
P.	100b	Q.	Corridor	R. #### S. ADMINISTRATION	T.	U.	-	V.	A
W.	113	X.	Corridor	Y. #### Z. ADMINISTRATION	AA.	BB.	-	CC.	A
DD.	109	EE.	113	FF. GG. RESTROOM	HH.	II.	Unisex international symbol of Accessibility	JJ.	G
KK.	110	LL.	113	MM. NN. RESTROOM	OO.	PP.	Unisex international symbol of Accessibility	QQ.	G
RR.	15	SS.	Corri	TT.	VV.	WW.	Unisex international	XX.	G

2	do r	UU. RESTROOM		symbol of Accessibility	
YY. 1 5 3	ZZ. Co rri do r	AAA. BBB. RESTROOM	CCC	DDD. Unisex international symbol of Accessibility	EEE. G
FFF. 1 0 2	GGG. 11 3	HHH. #### III. SCHOOL RESOURCE OFFICER	JJJ.	KKK. -	LLL. E
MMM. 1 0 3	NNN. 11 3	OOO. #### PPP. SICK	QQQ	RRR. -	SSS. E
TTT. 1 0 4	UUU. 11 3	VVV. #### WWW. PRINCIPAL	XXX	YYY. -	ZZZ. E
AAAA. 0 5	BBBB. 1 13	CCCC. #### DDDD. VICE PRINCIPAL	EEE	FFFF. -	GGGG. E
HHHH. 0 6	IIII. 11 3	JJJJ. #### KKKK. STORAGE	LLLL	MMMM. -	NNNN. A
OOOO. 0 7	PPPP. 1 13	QQQQ. #### RRRR. CONFERENC E		SSSS. -	TTTT. A
UUUU. 1 1	VVVV. 1 13	WWWW. #### XXXX. WORK ROOM	YYY	ZZZZ. -	AAAAA. A
BBBBB 1 2	CCCCC. 1 13	DDDDD. #### EEEEE. FILES	FFF	GGGGG. -	HHHHH. A
IIIII. 1 1 4	JJJJJ. Ex ter ior	KKKKK. FIRE RISER ROOM		LLLLL. -	MMMMM. F
NNNN 5 0	OOOOO. orr ido r	PPPPP. #### QQQQQ. CLASSR OOM	RRR	SSSSS. -	TTTTT. A
UUUU	VVVVV. C	WWWWW. ####	YYY	ZZZZZ. -	AAAAAA. A

51	orrido r	XXXXX. CLASSROOM			

END OF SECTION 101423

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Division 01 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:

1. Corner guards.
2. Fiber reinforced panels.

B. Related Requirements:

1. Section 092900 “Gypsum Board” for finished wall surface.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Material certificates.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Lifetime, from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.2 CORNER GUARDS **CG-1**

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product**:** Subject to compliance with requirements, provide InPro Corporation (IPC); #430 Stainless Corner Guard (Surface Mount). or a comparable product by one of the following:

a. Construction Specialties, Inc.
b. WallGuard.com.

2. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0625 inch (18-gauge.
b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 1-1/2 by 1-1/2 inches.
4. Corner Radius: 1/8 inch.
5. Mounting: Apply a bead of PL Premium Heavy Duty Adhesive in a zigzag pattern over the back of each wing of the corner guard. Position corner guard on the wall and apply pressure until a tight fit is achieved.

2.3 ABUSE-RESISTANT WALL COVERINGS **FRP-1**

A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Floor Products Company, Inc.
b. Construction Specialties, Inc.
c. Pawling Corporation.
d. WallGuard.com.

2. Size: 48 by 48 inches (1219 by 1219 mm) for sheet.
3. Sheet Thickness: 0.060 inch (1.5 mm).
4. Color and Texture: Match Crane Composites #085 “White” in Texture Smooth.
5. Height: 4 feet installed above base.
6. Joint Moldings: Extruded rigid plastic that matches wall-covering color.
7. Trim: Manufacturer’s recommended metal edge.
8. Mounting: Adhesive.

2.4 MATERIALS

A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

B. Adhesive: As recommended by protection product manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Adjust top and bottom caps as required to ensure tight seams.

END OF SECTION 102600

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SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Contractor-Furnished, Contractor-Installed (C.F.C.I.) toilet accessories.

1. Mirrors
2. Grab bars
3. Soap dispensers
4. Toilet paper dispensers
5. Sanitary napkin disposals
6. Toilet seat cover dispensers
7. Coat Hooks

B. Related Sections include the following:

1. Division 06 Section “Miscellaneous Rough Carpentry” for wood blocking in frame walls for surface-mounted items.
2. Division 06 Section “Interior Architectural Woodwork” for paneling substrate for accessories.
3. Division 09 Sections “Gypsum Board” and "Tiling" for wall substrate for accessories.
4. Section 224000 “Plumbing Fixtures” for fixtures.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

D. Owner will provide the following information to the Contractor, through the Construction Manager, for O.F.O.I. accessories, for coordination of the Work:

1. Product Data: For each type of O.F.O.I. accessory indicated. Include the following:

a. Materials and finish, installation details, and roughing-in and mounting measurements.

2. O.F.O.I. Accessories are as follows:

a. Paper Towel Dispensers, "**E**."

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for each accessory is based on the named product in the schedule that follows. Subject to compliance with requirements, provide either the named product or a comparable product by one of the manufacturers listed below, with prior written approval of Architect:

1. Toilet Accessories:

a. A & J Washroom Accessories, Inc.

b. American Specialties, Inc.
c. Bobrick
d. Bradley Corporation.
e. GAMCO - General Accessory Manufacturing Co.

B. Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. Additional construction costs required for the incorporation of a comparable product into the Work shall be the responsibility of the Contractor.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

G. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 CONTRACTOR-FURNISHED, CONTRACTOR-INSTALLED (C.F.C.I.) TOILET ACCESSORIES

A. Soap Dispenser, “**C**”: Surface-mount: Bradley 6562, Stainless steel, satin finish.

B. Grab Bars, “**B**”:

1. Provide one (1) of each length at each accessible water closet as indicated: Bradley 812.001-36, 812.001-42, & 812.001-18 (vertical unit) with safety grip surface, satin finish.

C. Channel Frame Mirror, “**A**”: Bradley 781 (24” X 36”), satin finish.

D. Toilet Tissue Dispenser, “**F**”: Bradley 5123-52, Polished Stainless Steel.

1. Semi-Recessed Hinged Hood Dual Roll Toilet Paper Dispenser with Anti-theft spindle.

E. Sanitary Napkin Disposal, "**G**"**:** Surface-mount, Bradley 4722-15, Stainless Steel, Satin finish.

F. Coat Hook, "**D**": Bradley 9134 Stainless Steel Hat and Coat Hook, Satin Finish

G. Toilet Seat Cover Dispenser, "**I**": Bradley 583 High Capacity Surface Mounted Seat Cover Dispenser, Stainless Steel, Satin finish.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 210500 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.

C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY

A. This Section specifies the basic requirements for fire protection installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.3 FIRE PROTECTION INSTALLATIONS

A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.

D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to

conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

F. Before any work is installed, determine that pipe and equipment will properly fit the space; that required piping grades can be maintained and that piping can be run as intended without interferences between systems, structural elements or work of other trades.

G. Verify all dimensions by field measurements.

H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.

I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

K. Install pipe and equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.

M. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

N. In general, all “static” piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all equipment, opening/closing of all valves, draining/refilling all systems and operating/verifying the operation of all systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.4 coordination

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, devices, etc., necessary to overcome congested conditions at no increase in contact sum. **The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts and shop drawings. Increases to contract sum or schedule shall not be considered for such effort.**

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Contractors.

C. Existing Conditions:

1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing drawings.
2. Contractor shall be responsible for showing all existing conditions on the shop drawings.
3. Provide proper coordination of mechanical work with existing conditions.
4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 coordination with other divisions

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains
4. Plumbing vent piping
5. Low pressure ductwork and air devices.
6. Electrical and communication conduits, raceways and cabletray.
7. Domestic hot and cold water
8. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
9. DDC control wiring and other low voltage systems.
10. Fire alarm systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.

G. Modifications required as a result of failure to resolve interferences, provide correct shop drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.6 design work required by contractor

A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of shop drawings shall be the complete responsibility of the Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Final coordinated distribution of fire protection and other systems within the ceiling cavity.
2. Any system not fully detailed
3. Equipment supports, hangers, anchors, and seismic systems not fully detailed nor specified in these documents or catalogued by the manufacturer.
4. Seismic restraint systems

D. Design Limitations:

1. The Contractor shall not modify the Engineers design intent in any way.
2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
3. The Contractor shall conform to the NFPA and IFC when design and installing fire protection systems.

1.7 PROJECT CONDITIONS

A. The Contractor shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

B. Field verify all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.

G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.

H. Coordinate all services shutdown with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.

I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.8 SAFETY

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

A. Refer to Division 1 and conform with the State and Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES

A. Refer to Division 1.

B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, , EPA, and OSHA.

C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies as outlined and adopted by State Fire Marshal.

D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.11 PERMITS AND FEES

A. Refer to Division 1.

B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

B. All systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.13 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and Division 1.

B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

C. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:

1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment’s clearance requirements.
2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
3. Inclusion in the bid of any applicable costs for changes in prime bidder’s and their sub bidders’ work required to accommodate the utilization of the comparable product.
4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.15 SUBMITTALS

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.

5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:

    a. Product
    b. Plan Code (if applicable)
    c. Specification Section
    d. Manufacturer and Model Number

7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder or as required by Division 1.

B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If the contractor proposes alternates or substitutions in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards.

D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the State Fire Marshal and Authority having Jurisdiction and stamped by the respective Fire Marshall prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.

E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the SUBMITTAL CHECKLIST, at the end of this section.

F. The Design Professional’s review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

G. The Design Professional’s review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional’s judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall

clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

K. The contractor shall cloud all changes made on submittals that are marked “Revise and Resubmit.”

L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

A. Product Listing:

1. Prepare listing of major l equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.

    a. Provide all information requested.
    b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."

2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
3. When two or more items of same material or equipment are required (pipe, valves, sprinklers, fittings, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), wire, steel bar stock, welding rods, fasteners, and similar items used in work, except as otherwise indicated.

    a. Provide products which are compatible within systems and other connected items.

B. Schedule of Values

1. Provide preliminary schedule of values with product data submittal, within three (3) weeks from award of contract to successful bidder. Provide according to the following descriptions:

    a. Fire Protection

        1) Equipment
        2) Piping rough in
        3) Piping finish
        4) Testing and training

2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

a. Sizes.
b. Weights.
c. Speeds.
d. Capacities.
e. Piping and electrical connection sizes and locations.
f. Statements of compliance with the required standards and regulations.
g. Performance data.
h. Manufacturer's specifications.

D. Shop Drawings:

1. Shop Drawings are defined as sprinkler system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Shop Drawings, except diagrams, to accurate scale, min 1/8”-1'-0", unless otherwise noted.

a. Show clearance dimensions at critical locations.
b. Show dimensions of spaces required for operation and maintenance.
c. Show interfaces with other work, including structural support.

E. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

F. Operation and Maintenance Data: See separate paragraph of this specification section.

G. Record Drawings: See separate paragraph of this specification section.

1.17 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.

E. Coordinate deliveries of materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

F. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.

G. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.

1.18 DEMOLITION

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping and related items either as shown on the demolition drawings as being removed, or as required for the work. At the completion of the remodeling work or when directed by the Architect, all items demolished shall be removed from the premises.

C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

D. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.

1.19 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

B. Refer to Division 1.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.

F. Perform cutting, fitting and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work;
2. Remove and replace defective work;
3. Remove and replace work not conforming to requirements of the Contract Documents;
4. Remove samples of installed work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.

G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of piping, sprinklers, and other items made obsolete by the new work.

H. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.

1. ICRA procedures must be maintained during construction.

J. Locate identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Protect equipment and systems to remain.

1.20 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

C. Work through all coordination before rough-in begins.

1.21 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification.

C. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

D. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

E. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

F. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.

G. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.22 CLEANING

A. Refer to Division 1.

1.23 RECORD DOCUMENTS

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of devices, and similar units requiring periodic maintenance or repair; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and devices located and numbered, and with items requiring maintenance located; Change Orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping relocated more than 1foot-0inches from where shown on the drawings.

D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

E. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:

1. Red shall indicate new items, deviations and routing.
2. Green shall indicate items removed or deleted.
3. Blue shall be used for relevant notes and descriptions.

F. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

G. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.24 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1.

B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).

C. The testing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.

D. In addition to the information required by Division 1 for Maintenance Data, include the following information:

1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
2. Description of equipment, function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
3. Manufacturer's printed operating procedures to include start-up, routine and normal operating instructions; shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
5. Servicing instructions, including Contractor reports.
6. Manufacturer's service manuals for all equipment provided under this contract.
7. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
8. Complete recommended spare parts list.
9. System and Equipment Warranties.
10. Copies of all test reports shall be included in the manuals.
11. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
12. Final schedule of values with all mechanical change order costs included and identified.
13. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.

E. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.25 PROJECT CLOSEOUT List

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

B. The Contractor shall be responsible for the following Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.26 WARRANTIES

A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.

B. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.27 CONSTRUCTION REQUIREMENTS

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1. Up to date record drawings.
2. Submittals
3. Site observation reports with current status of all action items.
4. Test results; including recorded values, procedures, and other findings.
5. Outage information.

1.28 SUBMITTAL CHECKLIST

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
210500	Common Work Results for Fire Suppression	X	X	X	X	X		X	X
211000	Water Based Fire Protection	X	X	X	X	X		X	X

Notes:
[1] For Starters and Variable Frequency Drives
[2] Requires Review & Approval of calibrated balance valves from T & B Contractor
[3] See Specific Specification Section for Test & Certification Requirements

END OF SECTION 210500

SECTION 211000 – WATER BASED FIRE PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:

1. Pipe, fittings, valves and specialties.
2. Sprinklers and accessories.

B. Products furnished and installed include sprinkler head cabinet with spare sprinkler heads.

C. The work of this section includes design responsibility to be performed by a NICET Level III technical for the system being provided

D. The fire protection system work is an extension of the existing fire protection system. Provide all modifications to the existing system as required to complete the new work. Provide hydraulic calculations and shop drawings where required by the extent of the work or by the authority having jurisdiction.

1.2 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Other definitions for fire protection systems are listed in NFPA Standards 13, 13R, 14, 20 and 24.

C. Working plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 and 14 for obtaining approval of the authority having jurisdiction.

1.3 SYSTEM DESCRIPTION

A. Provide a complete fire sprinkler system for the entire building (including, but not limited to, electrical rooms, mechanical penthouses and accessible sections of air handling units,) except designated areas as shown on the drawings which will not require fire sprinkler coverage and will be specifically noted with "No A/S"

B. Fire protection system is a "wet-pipe" system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.

C. All fire protection systems shall be installed to meet NFPA requirements. Refer to structural drawings for seismic design requirements. Provide seismic bracing as required by NFPA.

1. Where any conflicts arise the more stringent requirements shall be applicable.

1.4 SUBMITTALS

A. Product data for each type sprinkler head, valve, piping and piping specialty, fire protection specialty, fire department connection and any equipment installed in accordance with the Contract Documents. Index per specification chapter and item number.

B. Shop drawings prepared in accordance with NFPA 13 identified as "working plans," including detailed riser schematics indicating pipe sizes and lengths; and hydraulic calculations, which have been approved by the authority having jurisdiction. Do not proceed with the installation of the work until Authority having Jurisdiction has approved the shop drawings and the the Architect/Engineer review of shop drawings is received.

C. Contractor shall stamp shop drawings indicating compliance with applicable codes and contract drawings. Contractor shall stamp drawing "Approved for Construction."

D. If more than two submittals (either for shop drawings or for record drawings) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

E. Maintenance data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection and hose valve specified, for inclusion in operating and maintenance manual specified in Division 1 and Division-21 Section "Common Work Results for Fire Protection".

F. Welder's qualification certificate.

G. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Materials and Test Certificate for Underground Piping" as described in NFPA 13.

H. Provide hydraulic calculations and shop drawings stamped and prepared b a NICET Level III technician familiar with this type of installation. NICET technician shall be a full time employee of the sprinkler company doing the work.

I. Fire sprinkler piping design drawings shall show all ductwork, air devices, lighting and electrical panels.

J. Shop drawings and hydraulic calculations shall be stamped and signed by the local fire prevention authority prior to submitting shop drawings to the Architect/Engineer.

1.5 HYDRAULIC DESIGN

A. The Fire Sprinkler System shall be hydraulically calculated by the Contractor. Pipe schedule method is acceptable only as allowed in NFPA 13 and local Fire Marshal.

B. The wet pipe fire sprinkler system for the building shall be hydraulically calculated to comply with NFPA-13 and the following criteria:

1. Light hazard occupancy for areas unless noted otherwise
2. Ordinary hazard occupancy Group 1 for the following and per NFPA

    a. Commercial kitchens/Food preparation areas
    b. Storage rooms (Storage below 8 ft high)
    c.

d. Laundries
e. Custodial closets.

3. Ordinary Hazard Group 2 for the following:

a. Flammable storage rooms
b. Storage rooms

4. Hose allowance shall comply with NFPA-13.

C. The final fire protection system demand shall be a minimum of 10 PSI below the water supply curve.

D. Velocities in pipes shall be shown on hydraulic calculations. Velocities in overhead piping shall not exceed 32 feet per second. Velocities in underground piping shall not exceed 16 feet per second per NFPA.

E. Allow 10 feet of loss for electric water flow switches and note on hydraulic calculations.

F. The Fire Protection Contractor shall provide as many sets of hydraulic calculations as necessary, performed and submitted to prove that the most remote and demanding areas are calculated.

G. Design information shall be permanently affixed to the main riser as described in NFPA-13.

H. Water flow data for bidding purposes is to be verified by contractor from local water purveyor::

I. The Fire Protection Contractor shall be responsible for water flow data from the appropriate water department. A copy of the water flow test data from the water department shall accompany the hydraulic calculations before hydraulically calculating equipment fire sprinkler system.

J. The pipe and valve sizes indicated on the drawings and details are minimum sizes to be used regardless of sizes allowed by hydraulic calculations.

K. If flexible sprinkler pipe heads are used increased pressure drop shall be included in hydraulic calculations.

L. Atriums, as defined by the International Building Code, shall be designed as a separate zone for activation of the smoke control system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by qualified installer. The contractor shall be licensed for the design and installation for the specific type of system in the jurisdiction where the work is to be performed and the State Fire Marshal. Upon request, submit evidence of such qualifications to the Engineer. Refer to Division-1 Section: "Definitions and Standards" for definitions for "Installers."

B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Specifications of Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3."

C. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 13 - Standard for the installation of Sprinkler System, including applicable seismic requirements.
2. NFPA 13R - Standard for the Installation of Sprinkler Systems in residential occupancies up to four stories.
3. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
4. NFPA 24 - Installation of Private Fire Service Mains and their applications.
5. NFPA 1961 - Standard for Fire Hose.
6. NFPA 1963 - Screw Threads and Gaskets for Fire Hose Connections.
7. UL and FM Compliance: All fire protection system materials and components shall be Underwriter's Laboratories and Factory Mutual listed as well as labeled for the application anticipated.
8. National Electrical Code (NEC).
9. International Building Codes, including applicable seismic requirements.
10. Requirements of the local Building Department and Fire Department.

D. Reference and standards listed are minimum requirements. Where more stringent requirements are specified or noted on the drawings, those shall be applicable.

1.7 SEQUENCING AND SCHEDULING

A. Schedule rough-in installations with installations of other building components.

B. Minimum time frame for notice of inspections, tests and meetings is five (5) days and list the persons to be notified.

1.8 EXTRA STOCK:

A. Heads: For each style and temperature range (and length for dry heads) required, furnish additional sprinkler heads per NFPA-13.

1. Obtain receipt from Owner that extra stock has been received.

B. Wrenches: Furnish 2 wrenches for each type and size of valve connection and fire hose coupling.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection systems.

B. All equipment used on this project shall be new and UL listed unless noted or specified otherwise.

2.2 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one of the following:

1. Gate Valves:

a. Nibco
b. Kennedy Valve
c. Mueller
d. Stockham
e. Grinnell
f. Milwaukee

2. Swing Check Valves:

a. Central
b. Mueller
c. Kennedy Valve
d. Star Sprinkler Corp.
e. Viking
f. Victaulic
g. Globe
h. Potter Roemer

3. Butterfly and Ball Valves:

a. Grinnell
b. Mueller
c. Victaulic
d. Milwaukee
e. Kennedy

4. Grooved Mechanical Couplings:

a. Gruvlok
b. Victaulic Company of America
c. Central Sprink, Inc.

5. Sprinkler Heads:

a. Automatic Sprinkler Corp. of America.
b. Tyco.
c. ITT Grinnell
d. Reliable Automatic Sprinkler Co., Inc.
e. Star Sprinkler Corp.
f. Viking Corp.
g. Globe

2.3 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Section 210500, in accordance with the following listing:

1. Pipe escutcheons.
2. Drip pans.
3. Pipe sleeves.
4. Sleeve seals.
5. Fire Barrier Penetration Seals.

2.4 BASIC SUPPORTS AND ANCHORS

A. General: Provide supports and anchors complying with NFPA in accordance with the following listing:

1. Hangers (which are acceptable for project) and hanger spacing shall be in accordance with NFPA-13.

2.5 PIPE AND TUBING MATERIALS (INSIDE BUILDING)

A. General: Refer to Part 3 Article "Pipe Applications" for identification of systems where the below specified pipe and fitting materials are used.

B. Steel Pipe: ASTM A 53, A795 or A135, Schedule 40 or Schedule 10, U.S. manufacture, black steel pipe, with antimicrobial coating, plain ends.

C. Bull Moose “Eddy-Thread” & “Eddy Flow”, Wheatland “Mega-Thread” & “Mega-Flow”, Allied Tube and Conduit Corporation "Super Flo" are acceptable to Schedule 40 pipe. Installation shall be per manufacturer's recommendations.

D. Schedule 5 pipe shall not be allowed.

E. The Corrosion Resistance Ratio of the pipe shall be 1.00 or greater. Documentation shall be presented with product submittal.

F. Schedule 10 pipe shall only be allowed for pipe sizes 2-1/2inches and larger.

G. Provide galvanized, schedule 40, piping system for drain risers.

H. Exterior piping shall be painted for corrosion protection. Coordinate finish color with architect.

2.6 FITTINGS (INSIDE BUILDING)

A. Cast-Iron Threaded fittings: ANSI B16.4, Class 125 standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1. Install steel pipe with threaded joints and fittings for 2inches and smaller and where shown on drawings.

C. Steel Fittings: ASTM A234, seamless or welded, for welded joints.

D. Grooved Mechanical Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S.

E. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll- grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

F. Grooved Mechanical Fittings and Couplings for the entire fire protection system shall be of the same manufacturer as submitted in shop drawing equipment review.

G. Cast-Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt spot faced.

H. Cast Bronze Flanges: ANSI B16.24, Class 300; raised ground face, bolt holes spot faced.

I. Plain end, hooker type, or push-on fittings or couplings shall not be allowed.

J. Bushings and reducing couplings shall not be allowed.

K. UL listed and Factory Mutual approved segmentally welded fittings are acceptable. Friction loss and flow data shall accompany hydraulic calculations.

2.7 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Gasket Materials: Thickness, materials and type suitable for fluid or gas to be handled, and design temperatures and pressures.

2.8 GENERAL DUTY VALVES

A. Gate Valves - 2 Inch and Smaller: Body and bonnet of cast bronze, 175-pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.

B. Gate Valves - 2-1/2 Inch and Larger: Iron body; bronze mounted, 175-pound cold water working pressure - non-shock. Valves shall have solid taper wedge; outside screw and yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A 126 Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open.

C. Butterfly Valves: 2-1/2inches to 12inches, grooved, ductile iron body and disc ASTM-536, disc EPDM coated, listed and approved minimum 175 psi service, actuator, self-contained supervisory switch, weatherproof approved for indoor or outdoor use.

D. Ball Valves: 1-1/2inches and smaller shall be threaded, forged brass construction, with Teflon seats and blow out proof stem. Ball shall be full port with chrome plated ball.

E. Ball Valves: 2inches to 3inches shall be listed to 300 p.s.i. with optional internal tamper switch. Body shall be ductile iron with corrosion resistant coating. Ball shall be 316 stainless steel, standard port design.

F. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast-iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

G. Double Check Valve Assembly: Double check valve assembly shall be UL listed for fire protection service and USC-CCCF approved. Installation arrangement shall be per manufacturer's recommendations.

H. Provide reduced pressure backflow preventer where required by authority having jurisdiction and/or water department having jurisdiction. See Part 2 Products under this Section for acceptable manufacturers and model number.

I. Post Indicator: Provide PIV where required by NFPA and AHJ.

2.9 BASIC METERS AND GAUGES

A. General: Provide meters and gauges complying with NFPA 13 appropriate for system pressures and applications.

1. Pressure gauges, 0-250 psi range.

2.10 ALARM DEVICE AND FIRE PROTECTION SPECIALTIES

A. General: Provide fire protection specialties, UL-listed, in accordance with the listing. Provide sizes and types which mate and match piping and equipment connections.

B. Water Flow Indicators: Vane type water flow detector, rated to 250 psig; designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 volts DC; complete with factory-set field-adjustable retard element to prevent false signals, tamper-proof cover which sends a signal when cover is removed, and with activation time retarding capability set at 30 seconds. The setting shall be verified through the inspectors test prior to final inspection.

C. Supervisory Switches: Provide products recommended by manufacturer for use in service indicated. SPST, normally closed contacts, designed to signal valve in other than full open position.

D. Pressure Switch: Indicating low pressure trouble in sprinkler system.

E. Pressure switch: Indicating flow in sprinkler system.

F. Low Air/Nitrogen Pressure Horn: Provide low air/nitrogen pressure horn as indicated.

G. Electric Alarm Bell: UL, vibrating metal bell, [**8**] [**10**] inch, red enamel factory finish, suitable for outdoor use, listed and labeled per NFPA 70 marked for intended location and application.

2.11 AUTOMATIC SPRINKLERS

A. Sprinkler Heads: Fusible link or frangible bulb type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal ½ inch discharge orifice, for "ordinary" temperature range with a minimum temperature of 155 degrees F. Provide "intermediate"

temperature heads in Electrical rooms, where required as noted in NFPA 13, and as required by the Authority having jurisdiction.

B. Sprinkler Head Finishes: Provide heads with the following finishes:

1. Upright, Pendent and Sidewall Styles: Factory brass, rough bronze finish for heads in unfinished spaces. Heads shall be stainless steel or wax coated where installed exposed to acids, chemicals, or other corrosive fumes.
2. Concealed Style: Rough brass, adjustable, with painted white cover plate in finished spaces.
3. Semi-Recessed Style: Bright chrome, with bright chrome escutcheon plate.
4. See drawings for additional sprinkler type requirements.

C. Sprinkler Head Cabinet and Wrench: Finished steel cabinet, suitable for wall mounting, with hinged cover and space for spare sprinkler heads plus sprinkler head wrench. Provide amounts of each style per NFPA-13. Locate head cabinet on shop drawing submittal.

D. Sprinkler Escutcheons:

1. Ceiling Mounted: Chrome plated steel one piece flat of 2 piece with 1” adjustment
2. Wall Mounted: Chrome plated steel one piece flat of 2 piece with 1” adjustment

E. Plastic fire sprinkler escutcheons are not acceptable.

F. Sprinkler Guards: UL 199, wire cage with fastening device for attaching to sprinkler head.

2.12 FLEXIBLE SPRINKLER HEAD CONNECTORS

A. General: UL listed, FM approved, braided corrugated annealed stainless-steel hose with support brackets and inlet/outlet nipples

B. Length: no longer than 48”

C. Flexible Tube: 304 stainless-steel

D. Braid: 304 stainless-steel

E. Outlet Extension Nipple (Straight): Steel (ASTM A53 A) with yellow zinc plating.

F. Inlet Nipple: Steel (ASTM A53 A) with yellow zinc plating

G. Seal: EPDM

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine rough-in for fire hose valves and cabinets to verify actual locations of piping connections prior to installing cabinets.

B. Examine walls for suitable conditions where cabinets are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS

A. Wet Pipe Systems

1. Pipe size 2” and smaller:

a. Schedule 40 Black Steel with threaded joints and threaded fittings.
b. Schedule 10 Black Steel with roll groove end fittings for steel pipe and grooved end couplings for steel pipe

2. Pipe Size 2-1/2” and larger:

a. Schedule 40 Black Steel with threaded joints and threaded fittings
b. Schedule 40 Black Steel with rolled groove ends, grooved fittings and grooved couplings for steel pipe.
c. Schedule 10 Black Steel with rolled groove ends, grooved fittings and grooved couplings for steel pipe.

3. Schedule 40 pipe acceptable manufacturers:

a. Bull Moose Eddy-Thread and Eddy-Flow
b. Wheatland Mega-Thread and Mega-Flow
c. Allied Tube
d. Conduit Corp Super-Flo
e. Installation shall be in accordance with manufacturers requirements.

3.3 PIPING INSTALLATIONS

A. Provide a minimum of 5 feet-0 inches cover for all underground pipe installations. Install in accordance with AWWA C600.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated. Drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.

1. Deviations from approved "working plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "working plans."

C. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

D. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Welded outlet branch pipe fittings are acceptable.

E. Install unions in pipe 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

F. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

G. For welded pipe, all cutouts (coupons) shall be removed prior to installation.

H. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.

I. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.

J. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.

K. All piping penetrating fire walls to structure shall be sleeved and sealed per specification Section 230509 “Mechanical Fire Stopping”.

L. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve.

M. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than ¼” and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.

N. The fire line entry valves shall have monitoring electrical switches, the wiring from which shall be carried to the fire annunciating panel.

O. The fire protection contractor shall be responsible for the coordination of his installation with all other contractors. See Section 210500 for prioritized components.

P. Protect adjacent area where pipe cutting and threading takes place (e.g. floors, ceilings, walls, etc.).

Q. There shall be no fire sprinkler piping in electrical rooms or IT/Technology rooms (with the exception of piping serving sprinklers directly in that room) no piping shall be installed over any electrical panels.

R. Provide spring-loaded check valve at top of drain risers.

S. Install pressure gauges on city and system sides of fire entry valve assembly per NFPA.

T. Install hangers straight and true and piping parallel to building lines.

U. Do not run wet sprinkler piping through areas subject to freezing.

3.4 PIPE JOINT CONSTRUCTION

A. Welded Joints: AWS D10.9, Level AR-3.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads.

4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings.

E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.5 VALVE INSTALLATIONS:

A. General: Install fire protection specialty valves, fittings and specialties in accordance with the manufacturer's written instructions, NFPA 13 and the authority having jurisdiction.

B. Gate Valves: Install electrically supervised-open indicating valves so located to control all sources of water supply except fire department and roof manifolds connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve.

C. Install approved double check valve assembly or reduced pressure backflow preventer in each water supply connection per city requirements. Provide check valve and indicating valve (with tamper switch) on the discharge side of reduced pressure backflow preventers. Both shut off and backflow valves are required.

3.6 SPRINKLER HEAD INSTALLATIONS

A. Any sprinkler heads with any paint on them shall be replaced. The sprinkler system shall then be hydrostatically tested again at the contractor's expense.

B. Sprinkler heads shall be positioned so as to comply with NFPA-13 for any obstructions. This includes, but is not limited to, soffits, surface mounted lights, large ducts, and indirect lighting arrangements. The Fire Protection Contractor is responsible for identifying these obstructions and designing the system accordingly.

C. Run piping concealed above heated furred ceilings and in joists to minimize obstructions. Expose only heads.

D. Protect exposed sprinkler heads against mechanical injury with standard guards. Provide sprinkler headguards in all gyms, mechanical, electrical, IT/technology, or storage rooms, and gyms, as well as exposed pendant heads which are installed less than 8 feet-0 inches A.F.F.

E. Provide heads in "pocketed" areas caused by exposed duct, piping or beams per NFPA.

F. Sprinkler head deflector distance from face of finished ceiling per NFPA.

G. Sprinkler heads shall be located in the center of all 2-foot x 2 foot ceiling tiles and quarter points, along the center line lengthwise of 2 foot x 4 foot ceiling tiles.

H. Use proper tools to prevent damage during installations.

I. Install sprinkler piping in a manner such that mechanical equipment, ceiling tiles or lights can be accessed and easily removed. The sprinkler piping shall be installed to provide a minimum of 6 inches above the top of a finished ceiling where space allows.

J. Minimum fire sprinkler head temperature rating for sprinklers in electrical rooms shall be 212 degrees F. Keep sprinklers as far from transformers and/or panels as spacing allows.

3.7 INSTALLATION OF BASIC IDENTIFICATION

A. Install fire protection signs and identification on piping in accordance with NFPA 13 and NFPA 14 requirements.

B. Install piping system labels to clearly identify all dry and preaction system piping. Follow requirements of Division 23 for label location and spacing.

3.8 INSTALLATION OF METERS AND GAUGES

A. Install meters and gauges in accordance with NFPA.

3.9 FIELD QUALITY CONTROL:

A. Flush, test and inspect sprinkler piping systems in accordance with NFPA 13, Standard for installation of sprinkler systems.

B. The fire sprinkler system shall not be connected to underground piping until the fire service main is tested and approved.

C. The Fire Protection Contractor shall conduct and bear the costs of all necessary tests of the fire protection work, furnish all labor, power and equipment. All piping shall be tested with water as required; the tests witnessed by the authority having jurisdiction.

D. The fire protection piping shall be tested under a hydrostatic pressure of not less than pressure per NFPA, for a duration of not less than 2 hours.

E. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system at Fire Protection Contractor's expense.

F. All piping tests (pneumatic and hydrostatic) shall be conducted prior to the application of any painting materials. This will prevent hidden leaks and/or repainting of repaired/altered piping.

3.10 FINAL INSPECTION AND TESTING

A. The Contractor shall make arrangements with the Owner and Fire Marshal for final inspection and witnessing of the final acceptance tests. The Fire Protection Contractor, the Alarm System Contractor and the Owner will conduct the final inspection and witness the final acceptance test.

B. All tests and inspections required by the referenced Codes and Standards, and the Owner shall be performed by the Contractor.

C. The inspecting committee as referenced above will visit the job site to inspect the work and witness the final acceptance tests when they have been advised by the Contractor that the work is completed and ready for test. If the work is not complete or the test is unsatisfactory, the Contractor shall be responsible for the Consultant's extra time and expenses for re-inspection and witnessing the re-testing of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.

D. After the system has been inspected and tested, a certificate, "Contractor's Material and Test Certificate Sprinkler System - Water Spray System," shall be provided by the contractor and shall be signed by him or his representative, the Owner's representative and by a representative of the fire department. Sufficient copies shall be prepared to ensure the Engineer, Owner, all inspecting authorities and the contractor have a copy for their files. The Contractor shall prepare one (1) test report for each inspection performed whether successful or not.

E. The signing of the certificate by the Owner's representative shall in no way prejudice any claim against the contractor for faulty material, poor workmanship, or failure to comply with inspecting authority's requirements or local ordinances.

F. Contractor shall provide at least five (5) working days' notice for all tests.

G. All sprinkler supervisory initiating devices shall be functionally tested to verify proper operation.

H. All supervisory functions of each initiating device shall be functionally tested.

I. Receipt of all alarm and trouble signals, initiated during the course of the testing, shall be verified at the fire alarm control panel.

3.11 WORK BY OTHERS

A. Wiring of all water flow switches and tamper switches on valves to central alarm panel are by Division 26. Coordinate requirements.

3.12 OPERATION AND MAINTENANCE MANUAL

A. The Contractor shall provide the Owner with a loose-leaf manual containing:

1. A detailed description of the systems.
2. A detailed description of routine maintenance required or recommended or which would be provided under a maintenance contract including a maintenance schedule and detailed maintenance instructions for each type of device installed.
3. One copy of NFPA-25.
4. Manufacturers' data sheets and installation manuals/instructions for all equipment installed.
5. A list of recommended spare parts.
6. Service directory, listing the specific equipment items and where parts can be obtained, with name, address and telephone number.
7. Set of the record drawings (PDF format).
8. Hydraulic calculations
9. Test certificates.

B. Refer to Division 1 and Section 210500 for additional requirements.

C. Within 15 days of the completion of the work, six (6) copies of the manual shall be submitted for approval.

3.13 RECORD DRAWINGS

A. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawing prints which shall be marked to show each and every change made to the sprinkler system from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings approved by the Owner without written instruction from the Owner in each case. This set of drawings shall be used only as a record set.

B. Upon completion of the work, the record set of prints shall be used to prepare complete, accurate final record drawings reflecting any and all changes and deviations made to the sprinkler system.

C. The Owner, at his option and at the Contractor's expense, may require revised hydraulic calculations depending on the extent and nature of field changes.

D. The Record Drawings and Hydraulic Calculations shall have the signed stamp of the individual who prepared the design certifying the Record Drawings and the Hydraulic Calculations accurately represent the completed fire protection system.

E. Upon completion of the work, PDFs of the record drawings shall be submitted to the Architect/Engineer and Owner for review. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

3.14 GUARANTEE PERIOD

A. Guarantee: The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by him (or his subcontractors) or by defects in his (or his subcontractors') work, materials, or equipment.

B. Emergency Service: During the installation and warranty period, the Contractor shall provide emergency repair service for the sprinkler system within four hours of a request by the Owner for such service. This service shall be provided on a 24 hour per day, seven days per week basis.

3.15 TRAINING

A. The Contractor shall conduct two (2) training sessions of four (4) hours each to familiarize the building personnel with the features, operation and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a time mutually agreeable to the Contractor and the Owner.

3.16 WATER DAMAGE

A. The Fire Protection Contractor shall be responsible for any damage to the work of others, to building and property/ materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings, and shall pay for necessary replacement or repair of work or items so damaged during the installation, testing or guarantee periods of the automatic sprinkler work.

END OF SECTION 211000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1. RELATED DOCUMENTS

B. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

C. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.

D. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

E. Contractor shall be defined as any and all entities involved with the construction of the project.

1. SUMMARY

F. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Equipment installation requirements common to equipment sections.

3. DEFINITIONS

G. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

I. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

K. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

L. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

3. SUBMITTALS

M. Comply with Division 1 and requirements specified herein.

1. QUALITY ASSURANCE

N. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

O. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

P. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. DELIVERY, STORAGE, AND HANDLING

Q. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1. PLUMBING INSTALLATIONS:

R. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the plumbing work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.

S. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

T. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.

U. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

V. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

W. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.

X. Verify all dimensions by field measurements.

Y. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.

Z. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

AA. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

BB. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

CC. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.

DD. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset and install system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

EE. In general, all “static” piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

FF. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all plumbing equipment, opening/closing of all valves, draining/refilling all plumbing systems and operating/verifying the operation of all plumbing systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1. COORDINATION

GG. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.

HH. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21 and 23 Contractors.
2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.

3. Furnish building equipment (elevator, food service, medical, technology, etc) information to Div 21, 22, and 23 contractors.

II. Existing Conditions

1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing coordination.
2. Contractor shall be responsible for showing all existing conditions on coordination drawings.
3. Provide proper coordination of mechanical work with existing conditions.
4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

5. COORDINATION WITH OTHER DIVISIONS

JJ. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

KK. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains
4. Plumbing vent piping
5. Low pressure ductwork and air devices.
6. Electrical and communication conduits, raceways and cabletray.
7. Domestic hot and cold water
8. Hydronic piping
9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
10. DDC control wiring and other low voltage systems.
11. Fire alarm systems.

LL. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

MM. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

NN. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

OO. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.

PP. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

QQ. Coordination with Electrical Work: Refer to Division 1 and 26.

1. DESIGN WORK REQUIRED BY CONTRACTOR

RR. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.

SS. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.

TT. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
2. Any system not fully detailed
3. Fire protection systems
4. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
5. Temperature controls systems
6. Seismic restraint systems

UU. Design Limitations:

1. The Contractor shall not modify the Engineers design intent in any way.
2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
3. Back to back 90° fittings on piping system shall not be installed under any circumstance.
4. Bull nosed tees on piping systems shall not be installed under any circumstance.

5. PROJECT CONDITIONS

VV. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

WW. Field verify all conditions prior to submitting bids.

XX. Report any damaged equipment or systems to the Owner prior to any work.

YY. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.

ZZ. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

AAA. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.

BBB. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.

CCC. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.

DDD. Minimize disruptions to operation of mechanical systems in occupied areas.

1. REQUIREMENTS OF REGULATORY AGENCIES

EEE. Refer to Division 1.

FFF. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.

GGG. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies.

1. **Refer to the project code declaration sheet.**

HHH. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

III. The handling, removal and disposal of regulated refrigerants and other materials shall be in accordance with U.S. EPA, state and local regulations.

JJJ. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State or Local regulations.

KKK. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1. PERMITS AND FEES

LLL. Refer to Division 1.

MMM. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.

NNN. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1. PROJECT SEISMIC REQUIREMENTS

OOO. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

PPP. All systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the full responsibility of the Contractor.

QQQ. Refer to structural drawings for Seismic Design conditions

1. TEMPORARY FACILITIES

RRR. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.

SSS. Use of Permanent Building Equipment for Temporary Heating or Cooling: Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. Steam and hydronic systems shall be flushed and chemically treated. Ductwork and air moving equipment shall be cleaned to an “AS New” condition. All filters required for the construction period shall be equivalent to the filters required for the final installation. All filters shall be replaced at the time of substantial completion. The guarantee period of all equipment used shall not start until the equipment is turned over to the Owner for his use. A written record of maintenance, operation and servicing shall be turned over to the owner prior to final acceptance.

1. PRODUCT OPTIONS AND SUBSTITUTIONS

TTT. Refer to the Instructions to Bidders and Division 1.

UUU. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

VVV. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.

1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.

WWW. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:

1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment’s clearance requirements.
2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
3. Inclusion in the bid of any applicable costs for changes in prime bidder’s and their sub bidders’ work required to accommodate the utilization of the comparable product.
4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

5. SUBMITTALS

XXX. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:
   a) Product
   b) Plan Code (if applicable)
   c) Specification Section
   d) Manufacturer and Model Number
7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

YYY. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

ZZZ. All equipment shall conform to the State and/or local Energy Conservation Standards.

AAAA. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.

BBBB. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21, 22, and 23 Sections.

CCCC. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

DDDD. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

EEEE. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

FFFF. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

GGGG. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

HHHH. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."

IIII. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1. SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

JJJJ. Product Listing:

1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
   a) Provide all information requested.
   b) Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."

2. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.
   a) Provide products which are compatible within systems and other connected items.

KKKK. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:
   a) Sizes.
   b) Weights.
   c) Speeds.
   d) Capacities.
   e) Piping and electrical connection sizes and locations.
   f) Statements of compliance with the required standards and regulations.
   g) Performance data.
   h) Manufacturer's specifications.

LLLL. Shop Drawings:

1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8”-1'-0", unless otherwise noted.
   a) Show clearance dimensions at critical locations.
   b) Show dimensions of spaces required for operation and maintenance.
   c) Show interfaces with other work, including structural support.

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NNNN. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

OOOO. Operation and Maintenance Data: See separate paragraph of this specification section.

PPPP. Record Drawings: See separate paragraph of this specification section.

1. DELIVERY, STORAGE, AND HANDLING

QQQQ. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.

RRRR. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.

SSSS. Check delivered equipment against contract documents and submittals.

TTTT. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture. Refer to Division 1 for insurance requirements for offsite storage.

UUUU. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

VVVV. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.

WWWW. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

XXXX. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1. DEMOLITION

YYYY. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

ZZZZ. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.

1. Return all demolished control valves and devices to the Owner.
2. Return existing plumbing fixtures to the Owner.
3. Return existing medical gas outlets to the Owner.

AAAAA. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

BBBBB. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of the work, Contractor shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.

CCCCC. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim and other mechanical items made obsolete by the new work.

DDDDD. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.

EEEEE. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.

FFFFF. Locate, identify and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Cover openings in piping to remain. Protect equipment and systems to remain.

1. CUTTING AND PATCHING

GGGGG. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials.

HHHHH. Refer to Division 1.

IIIII. Do not endanger or damage installed work through procedures and processes of cutting and patching.

JJJJJ. Arrange for repairs required to restore other work, because of damage caused as a result of plumbing installations.

KKKKK. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.

LLLLL. Perform cutting, fitting and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work;
2. Remove and replace defective work;
3. Remove and replace work not conforming to requirements of the Contract Documents;
4. Remove samples of installed work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.

7. ROUGH-IN

MMMMM. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

NNNNN. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

OOOOO. Work through all coordination before rough-in begins.

1. ACCESSIBILITY

PPPPP. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

QQQQQ. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 8 for access door specification and Division 23 for duct access door requirements.

RRRRR. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

SSSSS. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

TTTTT. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

UUUUU. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.

VVVVV. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, sensors, motors, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1. EXCAVATING AND BACKFILLING

WWWWW. General:

1. Provide all necessary excavation and backfill for installation of mechanical work in accordance with Division 2.
2. In general, follow all regulations of OSHA as specified in "Excavations, Trenching and Shoring." Follow specifications of Division 23 as they refer specifically to the mechanical work.

XXXXX. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.

YYYYY. Pipe Trenching:

1. Provide all necessary pumping, cribbing and shoring.
2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.
3. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.

ZZZZZ. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

1. Provide detectable warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.
   a) Tape shall have magnetic strip and be used for exterior underground system only.

b. Trench Backfill:

2. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
3. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.
   a. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.

   b. This contractor shall repair and pay for any damage to finished surfaces.

   c. Complete the backfilling near manholes using pea gravel or squeegee, installing it in 6 inch lifts and mechanically tamping to achieve 95 percent compaction.

   d. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

4. NAMEPLATE DATA

AAAAAA. Provide permanent operational data nameplate, refer to the section on Plumbing Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1. CLEANING

BBBBBB. Refer to Division 1.

1. RECORD DOCUMENTS
   a. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

   b. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

   c. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, cleanouts, valves, and other control devices, strainers, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., strainers, expansion compensators, tanks, etc.); Change Orders; concealed system devices. Changes to be noted on the drawings shall include final location of any piping relocated more than 1foot-0 inches from where shown on the drawings.

NOTE: REFERENCES TO RFIs, PRs, CHANGE ORDERS, ETC., WILL NOT BE ACCEPTED AS AS-BUILT CONDITIONS.

d. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

e. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.

f. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:

1) Red shall indicate new items, deviations and routing.
2) Green shall indicate items removed or deleted.
3) Blue shall be used for relevant notes and descriptions.

g. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed

CCCCCC. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

**DDDDDD. **

1. OPERATION AND MAINTENANCE DATA
   a. Refer to Division 1.

   b. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).

   c. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.

   d. In addition to the information required by Division 1 for Maintenance Data, include the following information:

      1) The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
      2) Description of equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
      3) Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
      4) Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

5) Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
6) Manufacturer's service manuals for all equipment provided under this contract.
7) Include the valve tag list.
8) Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
9) Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
10) Complete recommended spare parts list.
11) Mechanical System and Equipment Warranties.
12) Copies of all test reports shall be included in the manuals.
13) Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
14) Final schedule of values with all mechanical change order costs included and identified.
15) Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.
16) Backflow preventor test certification.

a. \

e. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

2. PROJECT CLOSEOUT LIST
a. In addition to the requirements specified in Division 1, complete the requirements listed below.

b. The Contractor shall be responsible for the following Plumbing Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

3. WARRANTIES
a. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire plumbing system shall be warranted no less than one year from the time of acceptance by the Owner.

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b. Compile and assemble the warranties specified in Division 21, 22, and 23, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference or include the Operating and Maintenance Manuals.

c. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names,

addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

4. CONSTRUCTION REQUIREMENTS
   a. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1) Up to date record drawings.
2) Submittals
3) Site observation reports with current status of all action items.
4) Test results; including recorded values, procedures, and other findings.
5) Outage information.
6) \

PART 2 - PRODUCTS

1. MANUFACTURERS

B. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. PIPE, TUBE, AND FITTINGS

C. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

D. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

1. JOINING MATERIALS

E. Refer to individual Division 22 piping Sections for special joining materials not listed below.

F. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

G. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

H. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

I. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

J. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

1. TRANSITION FITTINGS

K. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

5. DIELECTRIC FITTINGS

L. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

M. Insulating Material: Suitable for system fluid, pressure, and temperature.

N. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

O. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

P. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

Q. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

R. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2. MECHANICAL SLEEVE SEALS

S. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic Carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

5. SLEEVES

T. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

U. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

V. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

W. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

X. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

Y. PVC Pipe: ASTM D 1785, Schedule 40.

Z. Molded PE: PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

1. ESCUTCHEONS

AA. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

BB. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

CC. One-Piece, Deep-Pattern Type: Deep-drawn, steel chrome plated spring clip fasteners, box-shaped brass with polished chrome-plated finish.

DD. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated, Rough brass or Polished chrome-plated and rough brass.

EE. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

FF. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

GG. One-Piece, Floor-Plate Type: Cast-iron floor plate.

HH. \

1. GROUT

II. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

1. PIPING SYSTEMS - COMMON REQUIREMENTS

B. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

D. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install piping to allow application of insulation.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel or stainless steel type.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel or stainless steel type and set screw.
f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel or stainless steel type with concealed hinge and set screw or spring clips.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
h. Bare Piping in Equipment Rooms: One-piece, stamped-steel or stainless steel type with set screw or spring clips.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use 2-piece hinged chrome plated steel escutcheons.

N. Sleeves are not required for core-drilled holes.

O. Permanent sleeves are not required for holes formed by removable PE sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inchesabove finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inchannular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6and larger, penetrating gypsum-board partitions.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inchannular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inchesin diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Rated Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

1. PIPING JOINT CONSTRUCTION

U. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

V. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

W. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

X. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

Y. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

Z. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

AA. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

BB. Non-Pressure PVC Joints: Clean and dry joints and surfaces. Make joints complying with ASTM F402 Safe Practices for Cleaners, Primers, and Cements. Join PVC in accordance with ASTM D2855 and D2665. Remove burrs and cuttings prior to joint pipe and fittings

CC. Hubless Cast Iron: Join in accordance with CISPI Handbook for Cast Iron Soil Pipe and Fittings and CISPI 310.

DD. Hub and Spigot Cast Iron: Join gasketed joints in accordance with CISPI Cast Iron Soil Pipe and Fittings Handbook

EE. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

1. PIPING CONNECTIONS

FF. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

5. PAINTING

GG. Painting of plumbing systems, equipment, and components is specified in Division 09.

HH. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

1. ERECTION OF METAL SUPPORTS AND ANCHORAGES

II. Refer to Division 05 for structural steel.

JJ. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

KK. Field Welding: Comply with AWS D1.1.

1. GROUTING

LL. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

MM. Clean surfaces that will come into contact with grout.

NN. Provide forms as required for placement of grout.

OO. Avoid air entrapment during placement of grout.

PP. Place grout, completely filling equipment bases.

QQ. Place grout on concrete bases and provide smooth bearing surface for equipment.

RR. Place grout around anchors.

SS. Cure placed grout.

MECHANICAL SUBMITTAL CHECKLIST

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
220500	Common Work Results For Plumbing			X					
220500	Final Schedule of Values			X		X			
220500	O&M Manuals		X	X		X			X
220500	Record Drawings	X	X	X					
220509	Firestopping	X	X	X					
220523	General duty Valves for Plumbing		X	X					
220529	Hangers & Supports for Plumbing & Piping Equipment		X	X					
220548	Vibration & Seismic Controls for Plumbing	X	X	X					
220553	Identification for Plumbing		X	X					

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Su-per-Vi-sion At Site	Train-ing Req'd At Site	Extra Mate-rial
		Shop Draw-ings	Product Data	Include In O & M	Test[3]	Report[3]			
220700	Plumbing Insulation		X	X					
221116	Domestic Water Piping		X	X					
221119	Domestic Water Piping Specialties		X	X					
221316	Sanitary Waste and Vent Piping		X	X					
221319	Sanitary Waste Pip-ing Specialties		X	X	X	X			
224000	Plumbing Fixtures		X	X					X

Notes: [1] For Starters and Variable Frequency Drives
[2] Requires Review & Approval of calibrated balance valves from T & B Contractor
[3] See Specific Specification Section for Test & Certification Requirements

END OF SECTION 220500

SECTION 220509 - PLUMBING FIRE STOPPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of firestopping required by this section is indicated on the drawings and by the requirements of this section. Refer to architectural plans and specifications for additional information.

B. Types of firestopping systems specified in this section include:

1. Bare metal pipe
2. Insulated metal pipe
3. Plastic piping

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacturing of firestopping systems for mechanical/electrical penetrations, whose products have been in satisfactory use for not less than 5 years, with published application data for all types of penetrations to be encountered on this job, and with local representation capable of providing training and technical assistance at the job site.

B. Installer's Qualifications: Personnel installing firestopping systems shall have been specifically trained by the manufacturer in the application of the materials to comply with the listing of the tested assembly.

C. Codes and Standards: Comply with the applicable State and Local codes pertaining to firestopping. Firestopping systems shall be tested and listed in accordance with the following:

1. Underwriter's Laboratory:

a. UL 1479 test method for fire tests of through-penetration firestops.
b. UL Fire Resistance Directory

2. American Society for Testing and Materials:

a. ASTM E814-88 Standard test method for fire tests of through-penetration firestops.
b. ASTM E2174 Standard practice for onsite inspection of firestop systems.

1.3 SUBMITTALS

A. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.

B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware and installation procedures, plus the following specific requirements:

1. Details of each proposed assembly, for all types of fire rated construction and penetrating items encountered, identifying intended products and applicable UL System Number, or UL classified devices.
2. Manufacture or manufacturer's representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

1.4 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. Deliver products in original, unopened packaging with legible manufacturer's identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and Protection: Store materials in a clean, dry ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.5 PROJECT CONDITIONS

A. Existing Conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental Requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the requirements of this specification, provide products by one of the following:

1. 3M, Fire Protection Products
2. Nelson Firestop Products
3. TREMCO Construction Products
4. Metalines
5. Hilti Corporation
6. Specified technologies, Inc. (STI)

2.2 GENERAL

A. Provide fire stop systems listed in the UL Fire Resistance Directory. Provide systems with fire resistance "F" ratings equal to the fire resistance rating of the wall or floor assembly for all penetrations. In addition, provide systems with a "T" rating equal to the fire resistance rating of the floor assembly for all floor penetrations not within the cavity of a wall.

2.3 ACCESSORIES

A. Provide forming and damming materials and sleeves as required by the firestopping system installation instructions.

PART 3 - EXECUTION

3.1 GENERAL

A. Review all project drawings, Owner’s records and existing conditions to determine location, rating, and construction of all fire resistive construction.

B. Coordinate location of penetrations to allow for the maximum and minimum annular space around the penetrating item. Allow a minimum of 1" undisturbed building material between penetrations, or provide a firestopping system listed for multiple penetrations. Penetrating items shall be centered in hole as much as practical, unless firestopping system is listed for point contact between the wall/floor assembly and the penetrating item.

C. Neatly form, saw cut, hole saw or core drill openings. Size openings to conform with the maximum and minimum annular space requirements of the firestopping system.

3.2 APPLICATION

A. The Contractor shall determine the most appropriate firestopping system which complies with these specifications and requirements for system being installed.

B. All insulation shall be continued through the penetration. Provide intumescent caulk or collar firestopping systems. Where the insulation thickness specified in Section 220700 exceeds the allowable insulation thickness for the firestopping system, reduce the insulation thickness 6 inches on either side of the penetration. Do not reduce insulation to less than 50 percent of the specified thickness.

C. Provide collar type firestopping systems where shown on drawings, and for hot piping systems at penetrations where significant thermal movement can be expected, such as near expansion compensation loops or joints.

D. See Section 220500 for sleeves. The use of sleeves may affect the "T" rating of the firestopping system. Coordinate use of sleeves with firestopping.

END OF SECTION 220509

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.

B. Related Sections

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use levers or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bronze Ball and Check Valves:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.
c. Hammond Valve.
d. Lance Valves.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.

2.2 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inchstem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig
c. CWP Rating: 200 psig
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded **OR** solder joint.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Chrome plated brass
j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Lead-Free Bronze Swing Check Valves with Nonmetallic Disc:

1. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig
c. Body Design: Horizontal or vertical upwards flow.
d. Body Material: ASTM B 584-C8936, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

2.5 DRAIN VALVES

A. For Plumbing Systems: Provide ball valve with threaded hose end and cap with chain.

B. Minimum ambient temperature limitation of 32 degrees F for any valve which contains water or water vapor and 0 degrees F where freezing water is not a factor. Special construction for ambient temperature down to -40 degrees F. Maximum ambient temperature limitation of 180 degrees F.

C. Parts in contact with fluid shall be brass, bronze, or stainless steel; core tube, 305 stainless steel; core and plug nut, 430 F stainless steel; Seal-BUNA “N”; shading coil copper; disc-BUNA “N” and Nylon; Spring, 302 stainless steel.

D. Manual reset safety shutoff valve shall open manually and close upon interruption of current

E. Electric current shall be of AC voltage shown on Division 26 drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball, butterfly valves NPS 4and larger and more than 96 inchesabove floor. Extend chains to 60 inchesabove finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use the following valves for series indicated

1. Plumbing Water Services: 3” and smaller: Ball Valve
2. Plumbing Water Services; 2-1/2” and larger: Butterfly valve or Ball Valve
3. Plumbing Balancing: Calibrated Balancing Valve

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125 or Class 150, nonmetallic disc.

B. Pipe NPS 2-1/2and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron or Bronze Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze or stainless-steel disc.
4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring or weight.
6. Iron, Center-Guided Check Valves: Class 125 or Class 150, globe or resilient seat.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Pipe positioning systems.

B. Related Sections:

1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

C. Refer to individual piping sections for hanger spacing requirements.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment .

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports

C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 22.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

a. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

b. Codes and Standards:

1) Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
2) NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system and NFPA Standard No. 14 when used as a component of a standpipe system, NFPA 99 shall be used for medical gas systems.
3) UL and FM Compliance: Hangers, supports, and components shall be listed and labeled by UL and FM where used for fire protection piping systems.

Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Hangers, supports, and components shall be listed and labeled by a NRTL where used for fire protection piping systems. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

4) MSS Standard Compliance:

a) Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.

B. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Pipe Hangers and Supports:

   a. ANVIL International
   b. B-Line Systems Inc.
   c. Erico
   d. Grinnell
   e. Hubbard Enterprises (Supports for domestic water piping)
   f. PHD Manufacturing, Inc.
   g. Specialty Products Co. (Supports for domestic water piping).
   h. Unistrut Metal Framing Systems

2. Shield and Thermal Shield Inserts:

   a. ANVIL International
   b. B-Line
   c. Erico
   d. Grinnell
   e. Pipe Shields, Inc.
   f. Snapp Itz
   g. Value Engineered Products, Inc.

3. Concrete Inserts and Anchors:

   a. B-Line
   b. Erico
   c. Grinnell
   d. Hilti
   e. ITW Ramset/Red Head
   f. Power-Strut
   g. Unistrut Metal Framing Systems
   h.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. General: Provide factory- fabricated hangers and supports complying with MSS SP-69, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select hangers and supports to suit pipe size and loading.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Powder driven fasteners subject to approval of Architect and Structural Engineer. Each fastener shall be capable of holding a test load of 1000 pounds whereas the actual load shall not exceed 50 pounds.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

C. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.

3.3 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inchesthick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder driven fasteners subject to approval of Architect and Structural Engineer. Each fastener shall be capable of holding a test load of 1000 pounds whereas the actual load shall not exceed 50 pounds.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units and within 1’-0” of each horizontal elbow.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Existing Construction:

1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Support firewater piping independently from other piping systems.

M. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers without isolation are not acceptable.

N. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.

O. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.

P. Where practical, support riser piping independently of connected horizontal piping.

Q. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.

R. Securely anchor and support plumbing domestic water piping in chases or walls using pipe positioning system. Use factory manufactured clamps and brackets connected to fixtures, waste/vent piping or brackets connected to studs. Wires or straps will not be permitted.

1. When copper supplies are connected to flush valves, support the tubing by the studs or by a fixture, not by clamping to waste/vent piping.
2. Prevent copper tubes from making contact with steel brackets using fire retardant polyethylene inserts or other dielectric insulating material. Duct tape shall not be used.

S. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:

1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.
2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than 6 inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any 50 successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.

3. Hangers for piping shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

T. Insulated Piping:

1. Attach clamps and spacers to piping.
2. Install MSS SP-58, Type 40, protective shields on all insulated piping 2 inches and less (except where required to be clamped). Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used.
b. Where necessary to prevent dislocation, strap shield to pipe with wire ties or “zip strips”.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

E. Use thermal-hanger shield inserts for insulated piping and tubing.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types: Note: provide rubber protection spacers between clamps and bare piping on piping where type 24, 26 and 59 clamps are used, oversize rubber spacer on multiple pipe hangers for compensating movement.

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Adjustable Band Hangers (MSS Type 9): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
4. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inchesfor heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg Fpiping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg Fpiping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb
    b. Medium (MSS Type 32): 1500 lb
    c. Heavy (MSS Type 33): 3000 lb

13. Side-Beam Brackets (MSS Type 34): For sides of steel beams.

J. Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
2. Existing Building Standards: Comply with the existing lettering size, length of color field, colors and identification method as presently exists in the existing building unless otherwise indicated.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Pipe Labels

a. Actioncraft Products, Inc.
b. Brady Corporation.
c. Brimar Industries, Inc.
d. Carlton Industries, LP.
e. Champion America.
f. Craftmark Pipe Markers.
g. emedco.
h. Kolbi Pipe Marker Co.
i. LEM Products Inc.
j. Marking Services, Inc.
k. Seton Identification Products.

2. Valve Tags

a. Actioncraft Products, Inc.
b. Brady Corporation.
c. Brimar Industries, Inc.
d. Carlton Industries, LP.
e. Champion America.
f. Craftmark Pipe Markers.
g. emedco.
h. Kolbi Pipe Marker Co.
i. LEM Products Inc.
j. Marking Services, Inc.
k. Seton Identification Products.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. or greater. Cut length to extend 2inches beyond each end of plastic pipe marker. Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length if there is an existing system.

B. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2inch.
3. Self-adhesive backing.

C. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Steel spring or non-metallic fasteners.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2inches wide; full circle at both ends of pipe marker, tape lapped 3inches.
3. Strapped-to-pipe (or insulation) application of semi- rigid type, with manufacturer's standard stainless-steel bands.

4. Self-Adhesive backing.

D. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system, if remodel, and abbreviate only as necessary for each application length.

E. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated comply with ANSI A13.1 for colors or to match existing building standard identification.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inchfor viewing distances up to 72 inchesand proportionately larger lettering for greater viewing distances.

G. Underground-Type Plastic Pipeline Markers:

1. General: Manufacturer's standard permanent, bright- colored, continuous-printed plastic tape with metal core for detection, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
2. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inchletters for piping system abbreviation and 1/2-inchnumbers (3/16” letters and 3/8” numbers for plastic) tag to be 1.5” for brass or laminate and 1.125” for plastic.

1. Tag Material: 19 ga. brass, 3/32” laminate manufacturer’s standard plastic, 0.032-inchstainless steel, 0.025-inchaluminum, 0.032-inchor anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.
3. Color: Fill engraving with black enamel for brass. For plastic and laminate, provide size, shape, and color combination as specified or scheduled for each system.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 15 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule: Per ANSI

D. Match color and system.

3.4 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping system, install continuous underground- type plastic line marker with metal detector strip, located directly over buried line at 6 inches to 8 inches below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For large fields and similar installations, mark edge pipe lines of field.

3.5 VALVE-TAG INSTALLATION

A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.

1. Building services main shut-off valves
2. Each individual system main shut-off valves
3. Each individual system riser shut-off valves
4. Each individual system floor shut-off valves
5. Each individual system major branch shut-off valves

B. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.

C. Where more than one major mechanical equipment room is shown for project, install mounted valve schedule in each major mechanical equipment room, and repeat only main valves which are to be operated in conjunction with operations of more than single mechanical equipment room.

D. Valve-Tag Application Schedule: Provide valve tags on all plumbing systems, size, shape and color scheme per ANSI. Refer to Part 2 for size and shape.

1. Valve-Tag Size and Shape: Per ANSI
2. Valve-Tag Colors: Per ANSI
3. Letter Colors: Per ANSI

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

a. Section Includes:

1) Insulation Materials:

a) Calcium silicate.

b. Fiberglass/ Mineral fiber
c. Flexible elastomeric

1) Insulating cements.
2) Adhesives.
3) Mastics.
4) Lagging adhesives.
5) Sealants.
6) Factory-applied jackets.
7) Field-applied jackets.
8) Tapes.
9) Securements.

d. Related Sections include the following:

1) Division 22 Section “Hangers and Supports for Plumbing and Piping Equipment”
2) Division 23 Section "HVAC Insulation."

e. Definitions

1) ASJ: All Surface Jacket.
2) FSK: Foil Scrim Kraft.
3) MRT: Mean Temperature Rating.
4) NRTL: Nationally Recognized Testing Laboratory
5) PCF: Pounds per Cubic Foot.
6) PSF: Pounds per Square Foot.
7) SSL: Self-sealing Lap

f. Codes and Standards:

1) International Energy Conservation Code currently adopted version.
2) ASHRAE 90.1, latest edition.

1.3 SUBMITTALS

a. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

b. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

c. Field quality-control reports.

1.4 QUALITY ASSURANCE

a. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

b. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

c. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1) Insulation: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

a. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, fire hazard indexes and maximum use temperature.

b. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.6 COORDINATION

a. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

b. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

c. Coordinate installation and testing of heat tracing if any.

1.7 SCHEDULING

a. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

b. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

a. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

1) Mechanical Insulation:

a) Aeroflex.
b) Armacell
c) CertainTeed
d) Einsulation
e) Johns Manville Corp.
f) Knauf Fiber Glass
g) Manson
h) Owens-Corning Fiberglas Corp.
i) Pittsburgh Corning Corp.
j) PABCO, Inc.
k) Rubatex Corp.
l) Thermal Structures

2) Jacketing & Covering Products:

a) Alpha Associates, Inc.
b) Ceel-Co
c) Childers
d) Polyguard
e) Venture Tape
f) Zeston

3) Insulating Cement :

a) Insulco,
b) P.K. Insulation Mfg. Co., Inc.
c) Rock Wool Manufacturing Company

4) Adhesives, Mastics, Sealants:

a) Childers Products, Fimasco Corporation
b) Foster Products Corporation, H.B. Fuller Company
c) ITW TACC, Division of Illinois Tool Works
d) Marathon Industries, Inc.

e) Mon-Eco Industries, Inc.

5) Tapes :

a) Avery Dennison Corporation, Specialty Tapes Division
b) Compac Corp.
c) Ideal Tape Co., Inc. An American Bilrite Company
d) Venture Tape

6) Field Applied Cloths :

a) Alpha Associates, Inc.

7) Field Applied Jackets :

a) Childers Products
b) Johns Mansville
c) PABCO Metals Corporation
d) P.I.C. Plastics, Inc.
e) Proto PVC Corporation
f) RPR Products, Inc.
g) Speedline Corporation

8) Securement :

a) C&F Wire
b) Childers Products
c) PABCO Metals Corporation
d) RPR Products, Inc.

2.2 INSULATION MATERIALS

a. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

b. Products shall not contain asbestos, lead, mercury, or mercury compounds.

c. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

d. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

e. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. ASJ-SSL Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint. “K” factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.

f. Flexible Elastomeric, Closed Cell Piping Insulation: ASTM C 534. Water vapor permeability of 0.10 perm inches or less. Insulation shall be pre-installed on piping, or un-slit to be slipped over piping as a single piece. “K” factor shall be maximum 0.245 at 50°F MRT, 0.25 at 75°F MRT and 0.26 at 90°F MRT.

2.3 INSULATING CEMENTS

a. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

b. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

a. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

b. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1) For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

c. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1) For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

a. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1) For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1) Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2) Service Temperature Range: Minus 20 to plus 180 deg F.
3) Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4) Color: White.

2.6 SEALANTS

a. FSK and Metal Jacket Flashing Sealants:

1) Materials shall be compatible with insulation materials, jackets, and substrates.
2) Fire- and water-resistant, flexible, elastomeric sealant.
3) Service Temperature Range: Minus 40 to plus 250 deg F.
4) Color: Aluminum.
5) For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

a. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1) ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2) ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.8 FIELD-APPLIED CLOTHS

a. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.9 FIELD-APPLIED JACKETS

a. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

b. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C.

1) Adhesive: As recommended by jacket material manufacturer.
2) Color: White.
3) Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a) Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.10 TAPES

a. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1) Width: 3 inches
2) Thickness: 11.5 mils
3) Adhesion: 90 ounces force/inchin width.
4) Elongation: 2 percent.
5) Tensile Strength: 40 lbf/inchin width.
6) ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

b. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1) Width: 3 inches.
2) Thickness: 6.5 mils.
3) Adhesion: 90 ounces force/inchin width.
4) Elongation: 2 percent.
5) Tensile Strength: 40 lbf/inchin width.

6) FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

c. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1) Width: 2 inches.
2) Thickness: 6 mils
3) Adhesion: 64 ounces force/inchin width.
4) Elongation: 500 percent.
5) Tensile Strength: 18 lbf/inchin width.

2.11 SECUREMENTS

a. Bands:

1) Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inchthick, 1/2 inchwide with wing or closed seal.
2) Stainless: ASTM A 167 or A240/A 240M. type 305 or 315, 0.015 inches thick, 3/4” wide with wing or closed seal.

b. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

c. Wire: 0.080-inchnickel-copper alloy, 0.062-inchsoft-annealed, stainless steel or 0.062-inchsoft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

a. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1) Verify that systems and equipment to be insulated have been tested and are free of defects.
2) Verify that surfaces to be insulated are clean and dry.
3) Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

a. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

b. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

c. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

a. All systems shall be insulated in accordance with the locally adopted energy codes or requirements of this specification section, whichever is more stringent.

b. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

c. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.

d. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

e. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

f. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

g. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

h. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

i. Install insulation with longitudinal seams at top and bottom of horizontal runs.

j. Install multiple layers of insulation with longitudinal and end seams staggered.

k. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

l. Keep insulation materials dry during application and finishing.

m. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

n. Install insulation with least number of joints practical.

o. Maintain integrity of vapor barrier jackets on cold pipe insulation, and protect to prevent puncture or other damage.

    1) Do not use staples or tacks on vapor barrier jackets.
    2) Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
    3) Seal fitting covers with PVC tape.

4) Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identity item covered.

p. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1) Install insulation continuously through hangers and around anchor attachments.
2) For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3) Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4) Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

q. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

r. Install insulation with factory-applied jackets as follows:

1) Draw jacket tight and smooth.
2) Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3) Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 incheso.c.

a) For below ambient services, apply vapor-barrier mastic over staples.

4) Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5) Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

s. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

t. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

u. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inchesbeyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

v. For above ambient services, do not install insulation to the following:

1) Vibration-control devices.
2) Testing agency labels and stamps.
3) Nameplates and data plates.
4) Manholes.
5) Handholes.

6) Cleanouts.

3.4 PENETRATIONS

a. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1) Seal penetrations with flashing sealant.
2) For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3) Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4) Seal jacket to wall flashing with flashing sealant.

b. Insulation Installation at Non-Fire Rated Interior Wall and Partition Penetrations: Install insulation continuously through walls and partitions.

c. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1) Comply with requirements in Divisions 07 and 22 for Firestopping and fire-resistive joint sealers.

d. Insulation Installation at Floor Penetrations:

1) Pipe: Install insulation continuously through floor penetrations.
2) Seal penetrations through fire-rated assemblies. Comply with requirements in Divisions 07 and 22.

3.5 GENERAL PIPE INSULATION INSTALLATION

a. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

b. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.

c. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

d. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1) Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2) Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams,

voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3) Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4) Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5) Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6) Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7) Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8) For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9) Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

e. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 FLEXIBLE ELASTOMERIC PIPING INSULATION

a. Install unslit, by slipping over piping prior to joining, or install pre-insulated soft copper tubing.

b. Seal butt ends with adhesive.

3.7 CALCIUM SILICATE INSULATION

a. Apply in a single layer. Secure to pipe with 1/2-inch-wide aluminum bands.

b. For indoor applications, provide canvas jacketing. Adhere joints of jacketing and provide a finish coat of sealant as recommended by the manufacturer.

3.8 MINERAL-FIBER INSULATION INSTALLATION

a. Insulation Installation on Straight Pipes and Tubes:

1) Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2) Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3) For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 incheso.c.
4) For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

b. Insulation Installation on Pipe Flanges:

1) Install preformed pipe insulation to outer diameter of pipe flange.
2) Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3) Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4) Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

c. Insulation Installation on Pipe Fittings and Elbows:

1) Install preformed sections of same material as straight segments of pipe insulation when available.
2) When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

d. Insulation Installation on Valves and Pipe Specialties:

1) Install preformed sections of same material as straight segments of pipe insulation when available.
2) When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3) Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4) Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

a. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1) Draw jacket smooth and tight to surface with 2-inchoverlap at seams and joints.
2) Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3) Completely encapsulate insulation with coating, leaving no exposed insulation.

b. Where FSK jackets are indicated, install as follows:

1) Draw jacket material smooth and tight.
2) Install lap or joint strips with same material as jacket.
3) Secure jacket to insulation with manufacturer's recommended adhesive.
4) Install jacket with 1-1/2-inchlaps at longitudinal seams and 3-inch-wide joint strips at end joints.
5) Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

c. Where metal jackets are indicated, install with 2-inchoverlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 incheso.c. and at end joints.

3.10 PIPING INSULATION SCHEDULE, GENERAL

a. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

b. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1) Underground piping unless noted otherwise
2) Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

a. Domestic Cold Water:

1) All Sizes: Insulation shall be the following:

a) Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1 inchthick.

b. Domestic Hot and Recirculated Hot Water (140°F and lower):

1) NPS 1-1/4and Smaller: Insulation shall be the following:

a) Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1 inchthick.

2) NPS 1-1/2and Larger: Insulation shall be the following:

a) Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1-1/2 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

a. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

b. If more than one material is listed, selection from materials listed is Contractor's option.

c. Piping, Concealed:

1) PVC Fitting Covers.
2) Aluminum, Smooth Stucco Embossed: thickness recommended per manufacturer.
3) Painted Aluminum, Smooth: thickness recommended per manufacturer.

2. Stainless Steel: thickness recommended per manufacturer.
3. PVC, Color-Coded by System: 20 mils thick

a. Piping, Exposed:

1) PVC Fitting Covers

4. Aluminum, Corrugated: thickness recommended per manufacturer.

1) Painted Aluminum, Smooth: thickness recommended per manufacturer.
2) Stainless Steel, Type 304,: 0.020 inch thick.

5. PVC, Color-Coded by System: 20 mils thick.

3.13 EXISTING INSULATION REPAIR:

a. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.

b. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

c. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Site/Civil documents for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: Submit industry standard and manufacturers technical product data, installation instructions, and dimensional drawings for each type of pipe and fittings. Submit schedule showing pipe or tube weight, fittings and joint type for each piping system.

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Division 1, Section 220500 “Common Work Results for Plumbing”, and Basic Requirements for administrative and procedural requirements for submittals

B. Certification of Compliance with ASME, NSP-61 and UL fabrication requirements.

C. Welding Certifications: Submit reports as required for piping work

D. Brazing Certifications: Submit reports required for piping work.

E. Test reports as specified in Part 3 of this section

F. Manufacturer and product data for lead free solder with material breakdown.

G. System purging and disinfecting activities report.

H. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Construction Manager's written permission.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Currently adopted local plumbing code
2. NSF Standard 61: “Drinking Water System Components”
3. ASME B 31.9 “Building Services Piping” for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
4. ASME “Boiler and Pressure Vessel Code”, Section IX, “Welding and Brazing Qualification” for Qualifications for Welding Processes and Operators
5. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of water distribution systems.
6. Local utility Department requirements
7. Local Cross Connection Control Manual
8. Local Engineering Standards

B. Manufacturers Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. Each manufacturer or contractor shall be responsible for the quality of soldering and brazing done by their organization and shall repair or replace any work not in accordance with these specifications.

D. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

1.7 DELIVER, STORAGE AND HANDLING

A. Store pipe in manner to prevent sagging and bending

B. Cap ends of piping when being stored.

C. Store all materials per manufacturer’s recommendations

1.8 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad, minimum of 6” from edges. Concrete, reinforcement and formwork requirements are specified in Division 3.

B. Coordinate the installation of pipe sleeves for foundation wall and floor penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Grooved End Copper Tubing Appurtenances

a. Anvil International.
b. Grinnell Mechanical Products.
c. Shurjoint Piping Products.
d. Victaulic Company.

2. Grooved End Stainless Steel Appurtenances

a. Anvil International.
b. Grinnell Mechanical Products.
c. Shurjoint Piping Products.
d. Victaulic Company.

3. Dielectric Unions

a. A.Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. Watts; a Watts Water Technologies company.
h. Wilkins.
i. Zurn Industries, LLC.

4. Dielectric Nipples

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products.
c. Matco-Norca.
d. Precision Plumbing Products.
e. Victaulic Company.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type K water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inchthick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: tube.

C. Color: natural.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

D. Plastic-to-Metal Transition Fittings:

1. Description:

a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Civil documents and Section 220500 for excavating, trenching, and backfilling. At minimum, provide 6” sand bed prior to backfill with native soil.

3.2 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design and the applicable referenced standards.

B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation

C. Do not proceed until unsatisfactory conditions have been corrected.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

D. Install drains in pressure pipe systems at al low points in mains and risers consisting of a tee fitting, 3/4-inch ball valve, and short 3/4 inch threaded end nipple and cap with chain.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Section 220509 for materials.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2and Smaller: Fitting-type coupling.
2. Fittings for NPS 2and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

D. Dielectric Fittings for NPS 5and Larger: Use dielectric flange kits.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feetand Less: MSS Type 1, adjustable, steel clevis or band hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100 Feetor Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4and Smaller: 60 incheswith 3/8-inchrod.
2. NPS 1 and NPS 1-1/4 72 incheswith 3/8-inchrod.
3. NPS 1-1/2 and NPS 2: 96 incheswith 3/8-inchrod.
4. NPS 2-1/2: 108 incheswith 1/2-inchrod.

F. Install supports for vertical copper tubing every 10 feet

G. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4and Smaller: 84 incheswith 3/8-inchrod.
2. NPS 1-1/2: 108 incheswith 3/8-inchrod.
3. NPS 2: 10 feetwith 3/8-inchrod.
4. NPS 2-1/2: 10 feetwith 1/2-inchrod. 10’ maximum
5. NPS 3 and NPS 3-1/2: 10 feetwith 1/2-inch rod.
6. NPS 4 and NPS 5: 10 feetwith 5/8-inchrod.
7. NPS 6: 10 feetwith 3/4-inchrod.
8. NPS 8 to NPS 12: 10 feetwith 7/8-inchrod.

H. Install supports for vertical stainless-steel piping every 15 feet.

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

E. Provide hot and cold-water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code. For fixtures with hot water service, extend hot water recirculation line out to fixtures greater than 20’ away from main or loop hot water line down to the fixture.

F. Connect hot and cold-water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection, provide drain valve on drain connection. Provide backflow preventor as shown as required. For connections 2-1/2” and larger, use flanges instead of unions.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psigabove operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppmof chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 6 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2and larger.
2. Throttling Duty: Use ball valves for piping NPS 2and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1. RELATED DOCUMENTS

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

1. SUMMARY

C. Section Includes:

1) Vacuum breakers.
2) Backflow preventers.
3) Balancing valves.
4) Strainers.
5) Outlet boxes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1) Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

1. MANUFACTURERS

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Drain Valves

a) Crane
b) Milwaukee
c) NIBCO
d) Apollo
e) Hammond
f) Watts Regulator

2) Strainers

a) Crane
b) Milwaukee
c) NIBCO
d) Apollo
e) Hammond
f) Lance
g) Watts Regulator

3) Vacuum Breakers

a) Woodford Manufacturing Co
b) Apollo
c) Nidel
d) Watts

4) Balancing Valves

a) Armstrong
b) Bell & Gossett
c) NIBCO
d) TACO
e) Watts
f) Apollo
g) Therm-Omega-Tech Circuit Solver

5) Flexible Connectors

a) MetraFlex
b) Hyspan
c) Wheatley

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psigunless otherwise indicated.

1. BALANCING VALVES

B. Copper-Alloy Calibrated Balancing Valves:

1) Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
2) Body: //Brass or bronze.

3) Size: Same as connected piping, but not larger than NPS 2

C. Cast-Iron Calibrated Balancing Valves:

1) Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2) Size: Same as connected piping, but not smaller than NPS 2-1/2

2.3 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1) Pressure Rating: 125 psigminimum unless otherwise indicated.
2) Body: Bronze for NPS 2and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2and larger.
3) End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2and larger.
4) Screen: Stainless steel with round perforations unless otherwise indicated.
5) Drain: Pipe blowdown valve with cap plug on 2-1/2 and larger.

2.4 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1) Mounting: Recessed.
2) Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
3) Faucet: Separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
4) Supply Shutoff Fittings: Quarter turn NPS 1/2ball valves and NPS 1/2copper, water tubing, integral shock arrestors.
5) Drain: NPS 2standpipe and P-trap for direct waste connection to drainage piping.

2.5 HOSE BIBBS

A. Hose Bibbs: Refer to fixture schedule on drawings.

1) Bronze body with replaceable bronzy seat and integral wall flange
2) 3/4” threaded or solder joint
3) Garden hose outlet ASME B1.20.7
4) Integral vacuum breaker per ASSE 1011
5) Chrome plated
6) Provide 2 keys

2.6 NON-FREEZE HYDRANTS

A. Non freeze Post Hydrants: Refer to fixture schedule on drawings.

1) Standard: ASME A112.21.3M.
2) Type: Non freeze, exposed-outlet post hydrant
3) Operation: Lever handle
4) Casing and Operating Rod: Of at least length required for burial of valve below frost line.
5) Casing: Bronze with casing guard

6) Inlet: NPS 3/4
7) Outlet: Garden hose thread complying with ASME B1.20.7
8) Drain: Designed with hole to drain into ground when shutoff
9) Vacuum Breaker:

b. Nonremovable, drainable, hose connection vacuum breaker complying with ASSE 1011 or backflow preventor complying with ASSE 1052
c. Garden hose thread complying with

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1) Standard: MSS SP-110 for standard-port, two-piece ball valves.
2) Pressure Rating: 400-psig minimum CWP.
3) Size: NPS 3/4
4) Body: Copper alloy.
5) Ball: Chrome-plated brass.
6) Seats and Seals: Replaceable.
7) Handle: Vinyl-covered steel.
8) Inlet: Threaded or solder joint.
9) Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1) Standard: ASSE 1010.
2) Type: Metal bellows or Copper tube with piston and EPDM O-rings.
3) Size: ASSE 1010, Sizes AA and A through F.

2.9 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1) Standard: ASSE 1044.
2) Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
3) Cabinet: Surface-mounted steel box with stainless-steel cover.
4) Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
5) Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Vacuum Breaker: ASSE 1001.
1) Number of Outlets: as required.
2) Size Outlets: NPS 1/2.

B. Electronic Single Drain Trap Primer:

1) Packaged unit with subminiature solenoid valve, adjustable timer, air gap fitting, electrical cord, and distribution fitting as required.

2) Coordinate electrical requirements with electrical contractor.
3) Unit to deliver 2 oz of water to trap every 24 hours.
4) Provide ball valve and unit for access and service.
5) Similar to PPP SMP-500 or Sioux Chief 695-ES01

2.10 FLEXIBLE CONNECTORS/SEISMIC FLEX JOINTS

A. Flexible Hose Connectors

1) Provide flexible hose expansion loop(s) as indicated on the contract drawings or as required to accommodate any thermal expansion, contraction or seismic movement of the piping systems.
2) Flexible hose expansion loops shall be manufactured complete with two parallel sections of corrugated metal house, compatible braid, 180 deg return bend, with inlet and outlet connections. Field fabricated loops shall not be acceptable.
3) Flexible loops shall be capable of movement in the ±X, ±Y and ±Z planes
4) Flexible hose expansion loops shall impart no thrust loads to system support, anchors or building structure.
5) For flammable liquid or gas service up to 4", flexible expansion loops shall be CSA/AGA certified.
6) All flexible hose expansion loops shall be manufactured in accordance with the documented manufacturers weld procedure specifications. The procedure qualification record shall be used to document the execution of this procedure and shall follow the general "guidelines" of ASME Section IX. Each individual welder shall conform to the in-house procedure qualification record and be qualified prior to each production lot. The testing of each individual welder shall be documented in a welding procedure qualification record.
7) Corrugated Hose

    a) Stainless Steel

        i. B.1.1 Type 304
        ii. B.1.2 Type 321
        iii. B.1.3 Type 316

8) Braid

    a) C.1 304 Stainless steel braid shall be used for any series 300 stainless steel hose.
    b) C.2 Bronze braid shall be used for any bronze hose

9) Fittings materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.
10) Flexible hose expansion loops shall have a factory supplied, hanger/support lug located at the bottom of the 180 deg return
11) Flexible hose expansion loop(s) shall be furnished with a plugged FPT to be used for a drain or air release vent.

	Loop Size	FPT Size
2.	1"-6"	3/8"
3.	8" & larger	1/2"

1) The operating pressure shall be based on burst pressure with a 4 to 1 safety factor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install balancing valves in locations where they can easily be adjusted.

B. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve and thermometer (2” diameter minimum) on outlet.

1) Install cabinet-type units surface mounted on wall as specified.

C. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.

D. Install outlet boxes recessed in wall or surface mounted on wall. Install wall reinforcement between studs.

E. Install supply-type, trap-seal primer valves only when approved by Engineer, with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

F. Install drainage-type, trap-seal primer valves only when approved by Engineer, as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

G. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow. Provide distributor as required. Pipe with 3/8 poly pipe to traps. Exposed piping to be chrome plated bronze.

H. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, clinical service sinks, dishwashers, disposals, clothes washers, ice makers, autoclaves, pre-rinse spray hose, etc. Install in accessible location. Refer to detail on drawings. Provide access doors in accordance with architectural recommendations if an isolation valve is installed.

I. Tailpiece trap primers: Pipe with 3/8” chrome plated brass tubing from primer connection into wall. Pipe within wall with copper to poly under floor to drain trap.

J. Install expansion fittings:

1) Install flexible hoses for seismic applications

3.2 CONNECTIONS

A. Comply with requirements for grounding of equipment in Division 26.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1) Calibrated balancing valves.
2) Outlet boxes.
3) Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

1. INSTALLATION OF PIPING SPECIALTIES

C. Drain Valves: Install drain valves on each plumbing equipment item, located to completely drain equipment for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to completely drain distribution piping system. For drain valves use ball valves.

D. Balance Valves: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.

E. Hose Bibbs: Install where indicated. Secure on unistrut to wall.

F. Install pressure regulating valves with inlet and outlet shutoff valves, and balance valve bypass.

G. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, clinical service sinks, dishwashers, disposals, clothes washers, ice makers, autoclaves, pre-rinse spray hose, solenoid valves, etc. Install in accessible location. Provide hinged metal access panel doors in accordance with architectural recommendations and provide isolation valve.

1) Units shall be sized in accordance with the following schedule:

2. Fixture Unit Rating	3. P.D.I Size
4. 1-11	5. A
6. 12-32	7. B
8. 33-60	9. C
10. 61-113	11. D
12. 114-154	13. E
14. 155-330	15. F

H. Install air vents at high points in piping. Provide ball shut off valve. Provide discharge piping turned down to allow discharge into bucket.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1) Test each pressure vacuum breaker, reduced-pressure-principal backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Inspections: Inspect domestic specialties as follows:

1) Do not enclose, over, or put into operation system until it has been inspected an approved by the authority having jurisdiction.
2) During the progress of the installation, notify the Local Authority Having Jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

a) Rough-in Inspection: Arrange for inspection of the piping system after the system is roughed-in but before concealing or closing in piping and prior to setting fixtures.

b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.

1) Reinspection: Whenever the plumbing official finds that piping system will not pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official
2) Reports: Prepare inspection reports, signed by the plumbing official.

C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:

1) Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.
2) Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, AWWA C652 or described below:

a) Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.

b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system.
e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities.

C. Set field-adjustable pressure set points of water pressure-reducing valves.

D. Set field-adjustable flow set points of balancing valves.

E. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

1. SYSTEM START UP

F. Fill the system.

G. Check compression tanks to determine that they are not air bound and that the system is completely full of water.

H. Before operating the system perform these steps:

1) Open valves to full open position. Close drains, valves, hydrants, and sill cocks.
2) Remove and clean strainers.
3) Check pump for proper direction of rotation. Correct improper wiring.
4) Lubricate pump motors and bearings.

I. Adjust pressure reducing stations, report downstream system static pressure.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Requirements:

1. Civil documents for sanitary sewerage piping and structures outside the building.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping" **OR** 220548.13 “Vibration Controls for Plumbing Piping”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner’s written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to , the following:

1. Cast Iron Pipe and Fittings

a. AB&I
b. Charlotte
c. Tyler Pipe

2. Standard Duty CISPI Couplings

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Clamp-All Corp.
d. Dallas Specialty & Mfg. Co.
e. MIFAB, Inc.
f. Mission Rubber Company, LLC
g. Stant.
h. Tyler Pipe

3. Cast Iron Hubless Piping Couplings

a. Charlotte Pipe and Foundry Company.
b. MG Piping Products Company.
c. Clampall
d. Ideal Tridon

2.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 and CISPI 301.

B. Standard Duty Hubless Couplings:

1. ASTM C1277 and CISPI 31
2. 304 stainless steel corrugated shell with stainless steel bands and tightening devices with ASTM C564 rubber sleeve with pipe stop.

C. Cast-Iron, Hubless-Piping Couplings:

1. Standard: CISPI-310 and ASTM C 1277.
2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:

a. Standard: ASTM C 1173.
b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Nonpressure Transition Couplings:

a. Standard: ASTM C 1460.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Civil documents. At minimum, provide 6” sand bed above and below prior to backfill with native soil.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. For Seismic Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drainpipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

K. Install 1-inch-thick extruded polystyrene over underground drainage piping that is above frost line and not under building. Provide width to extend minimum of 12 inches beyond each side of pipe. Install directly over pipe, centered on pipe center line.

L. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

3. Maintain swab in piping and pull past each joint as completed.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install steel piping according to applicable plumbing code.

O. All below grade plastic piping shall meet ASTM D2321-89 requirements

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Division 22.

T. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Division 22.

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Division 22.

3.3 JOINT CONSTRUCTION

A. Join hub and spigot cast iron pipe with gasket joints per CISPI Cast Iron Pipe & Fittings Handbook.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
c. Do not use pipe sections that have cracked or open welds.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inchesof each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inchminimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 incheswith 3/8-inchrod.
2. NPS 3: 60 inches with 1/2-inchrod.
3. NPS 4 and NPS 5: 60 incheswith 5/8-inchrod.
4. NPS 6 and NPS 8:60 incheswith 3/4-inchrod.
5. NPS 10 and NPS 12: 60 incheswith 7/8-inchrod.
6. Spacing for 10-footlengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."

D. Where installing piping adjacent to equipment allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

C. Install detectable warning tape within 6” of finish grade on exterior piping.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

E. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water based latex paint. Color selection shall be by Architect.

3.10 PIPING SCHEDULE

A. Note: Standard duty coupling may be used for waste and vent piping for up to 2 stories only.

B. NOTE: PVC waste and vent may not be used in return air plenums.

C. Aboveground, soil and waste piping NPS 4and smaller shall be any of the following:

1. Service wight cast iron with hub and spigot gasket joints and fittings.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
4. PVC pipe with socket fittings and solvent cement joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4and smaller shall be any of the following:

1. Service wight cast iron with hub and spigot gasket joints and fittings.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Copper Type DWV tube, copper drainage fittings, and soldered joints.

E. Underground, soil, waste, and vent piping NPS 4and smaller shall be any of the following:

1. Service wight cast iron with hub and spigot gasket joints and fittings.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. PVC pipe with socket fittings and solvent cement joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Through-penetration firestop assemblies.
3. Miscellaneous sanitary drainage piping specialties.
4. Floor Drains

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for roof and overflow drains.
2. Site/Civil Documents for "Sanitary Drainage Piping" for sewer drainage piping and piping specialties outside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Plumbing Code Compliance: Comply with applicable portions of Local Plumbing Code.
2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products and installation of soil and waste systems.
3. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of soil and waste systems.
4. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems
5. PVC Pipe: Only Contractors personnel which have received training in the installation of this material and meet the manufacturers qualifications shall do the assembly of such material.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate the installation of flashing and roof penetrations

B. Coordinate flashing materials installation of roofing, waterproofing and adjoining substrate work

C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing an slope of slab to drains.

D. Coordinate with installation of sanitary sewer systems as necessary to interface building drains with drainage piping systems.

E. Coordinate all penetrations with Structural Engineer

F. Coordinate all installations with work of other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

B. Cast Iron Exposed Cleanouts

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. MIFAB, Inc.
4. Tyler Pipe
5. Watts.
6. Zurn Industries, LLC.

C. Cast Iron Exposed Floor Cleanouts

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. Oatey
4. Sioux Chief Manufacturing Co
5. Tyler Pipe
6. Watts.
7. Zurn Industries, LLC.

D. Cast Iron Wall Cleanouts

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. MIFAB, Inc.
4. Tyler Pipe
5. Watts.
6. Zurn Industries, LLC.

E. Cast Iron Floor Drains

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. MIFAB, Inc.
4. Tyler Pipe
5. Watts.
6. Zurn Industries, LLC.
7. Commercial Enameling

2.2 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Raised-head, bronze plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Standard: ASME A112.36.2M for adjustable housing, cast-iron soil pipe with cast-iron ferrule or threaded, adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing, Cast-iron soil pipe with cast-iron ferrule or Threaded, adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Inside calk, Spigot or Threaded.
7. Closure: brass/bronze plug.
8. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
9. Frame and Cover Material and Finish: Rough bronze.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Light Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:

    a. Brass/bronze

b. Raised head.
c. Drilled and threaded for cover attachment screw.
d. Size: Same as or not more than one size smaller than cleanout size.

5. Wall Access: Round, deep, chrome-plated bronze or flat, chrome-plated brass or stainless-steel cover plate with screw.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Site Surface Cleanout: Cast iron body ferrule with raised head brass plug, medium duty cast iron manhole cover and ring 12-inch diameter to be set in concrete pad, Neenah No. R-1791-A

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

2.5 FLOOR DRAINS (FD)

A. Floor Drain types, designation and sizes are indicated on drawings.

B. Toilet Rooms and Finished Areas: Round cast iron body with flashing collar, seepage holes, and clamping ring when installed with membrane, 6” round nickel bronze adjustable strainer head with secured square hole grate, bottom outlet, and cast iron trap with primer connection. Provide center pin torx security screws on grate for all detention floor drains.

C. Boiler and Mechanical Rooms: Round cast iron, light duty, shallow body drain with flashing collar, seepage holes and cast iron clamping ring, when used with membrane, 8 inch round tractor type non tilt, slotted grate with sediment bracket, bottom waste outlet.

D. Ice Maker or Drip Pan Drain, Recessed Top Grate: Round cast iron body with flashing collar, weep holes, and clamping rings when used with membrane. Provide 7” round nickel bronze adjustable strainer head with loose set recessed square hole grate, bottom waste outlet with cast iron trap and primer connection. Top outside edge of drain to be set flush with finished floor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Install piping in accordance with Local Authority Having Jurisdiction (AHJ), except where more stringent requirements are indicated.

B. Inspect piping before installation to detect apparent defects. Mark defective materials and promptly remove from site.

C. Verify all dimensions by field measurements. Verify that all drainage, vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design and referenced standards.

D. Verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to installations.

E. Examine rough in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

F. Examine walls, floors, roof and plumbing chases for suitable conditions where piping and specialties are to be installed

G. Do not proceed until unsatisfactory conditions have been corrected.

H. Refer to Division 2 for trenching and backfill requirements.

3.2 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feetfor piping NPS 4and smaller and 100 feetfor larger piping.
4. Locate at base of each vertical soil and waste stack.
5. At each toilet group
6. At egress of building
7. At sinks and urinals on grade
8. Where required by plumbing code.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Lubricate metallic cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, relubricate and reinstall using only enough force to ensure permanent leakproof joint.

E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Division 07.

F. Assemble open drain fittings and install with top of hub 2 inches above floor.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

J. Install reinforcement for wall-mounting-type specialties.

K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is required. Prime all traps unless noted otherwise.

L. All floor drains are to be provided with P-trap the same size as the floor drain unless otherwise noted on mechanical drawings.

M. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and extend cleanouts to floor or wall above. Line cleanouts are not acceptable unless otherwise noted on the drawings.

1. As required by plumbing code.
2. At each change in direction of piping greater than 135 degrees below slab
3. At base of each vertical soil or waste stack
4. At sinks and urinals on grade
5. At egress of building (surface cleanout)
6. At each toilet group.

N. Cleanouts Covers: Install floor and wall cleanout covers, types as indicated, and in accessible locations.

O. Flashing Flanges: install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes

P. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer’s instructions.

3.3 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but in no case smaller than required by the plumbing code.

C. Install piping adjacent to equipment to allow service and maintenance.

3.4 PIPE AND TUBE JOINT CONSTRUCTION

A. Install pipes and pipe joints in accordance with Division 22.

3.5 INSTALLATION OF FLOOR DRAINS

A. Install floor drains in accordance with manufactures written instructions and in locations indicated.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Coordinate floor slopes and exact drain locations with Architectural drawings.

C. Trap all drains connected to the sanitary sewer with minimum trap size that of drain connected.

D. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

E. Position drains so that they are accessible and easy to maintain.

3.6 INSTALLATION OF TRAP PRIMERS

A. Install trap primers on all traps with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent) Adjust trap primer for proper flow.

3.7 FLASHING INSTALLATION

A. Comply with requirements in Division 07 for flashing.

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07.

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

H. Provide flashing membrane for all floor drains in structure above slab on grade level; see flashing detail on mechanical drawings.

I. Provide flashing for all floor drains, floor cleanouts in wet areas and shower drains above grade. Make watertight with underslab moisture vapor barrier. Refer to Division 7 for requirements of vapor barriers. Flashing shall extend at least 24 inches from drain rim into floor membrane or on structural floor. Fasten flashing to drain clamp device and make watertight, durable joint. Provide flashing collar extension with all drains and cleanouts installed above grade.

3.8 LABELING AND IDENTIFYING

A. Label Piping and Accessories

1. Pipe labeling is specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. Do not enclose, cover or put into operation drainage and vent piping system until it has been pressure tested, inspected and approved by the Local Authority Having Jurisdiction.

B. During the progress of the installation, notify the plumbing official having jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified in Division 22 in the presence of the plumbing official.

C. Perform tests and inspections and prepare test reports.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.10 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.11 ADJUSTING AND CLEANING

A. Clean interior of piping. Removed dirt and debris as work progresses

B. Clean drain strainers and traps. Remove dirt and debris.

C. END OF SECTION 221319

D.

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 22 Sections apply to this Section.

1.2 SUMMARY

A. This Section includes plumbing fixtures and trim, fittings and accessories, appliances, appurtenances, equipment and supports associated with plumbing fixtures.

B. Products furnished but not installed under this Section include:

1. Plumbing fittings (including faucets) and piping indicated for fixtures, appliances, appurtenances, and equipment provided by Owner.
2. Plumbing fittings (including faucets) and piping indicated for fixtures, appliances, appliances, appurtenances, and equipment specified in other sections.

C. Products installed but not furnished under this Section include:

1. Owner supplied fixtures, as indicated.
2. Accessories, appliances, appurtenances, and equipment specified in other sections requiring plumbing services or fixture related devices, as indicated.

1.3 DEFINITIONS

A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.

B. Accessory: Device that adds effectiveness, convenience or improved appearance to a fixture but is not essential to its operation

C. Appliance: Device or machine designed and intended to perform a specific function.

D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.

E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.

F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.

G. Fixture: Installed receptor connected to the water distribution system that receives and makes available potable water and discharges the used liquid or liquid borne wastes directly or indirectly into

the drainage system. The term “Fixture” means the actual receptor except when used in a general application where terms “Fixture” and Plumbing Fixture” include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.

H. Roughing In: Installation of piping and support for the fixture prior to the actual installation of the fixture.

I. Support: Device normally concealed in building construction for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:

1. Carrier: Floor mounted support for wall mounted water closet and support fixed to wall construction for wall hung fixture.
2. Chair Carrier: Support for wall hung fixture having steel pipe uprights that transfer weight to the floor.
3. Chair Carrier, Heavy Duty: Support for wall hung fixture having rectangular steel uprights that transfer weight to the floor.
4. Reinforcement: Wood blocking or steel plate built into wall construction for securing fixture to wall.

J. Trim: Hardware and miscellaneous parts specific to fixture and normally supplied with it required to complete fixture assembly and installation.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for each type of plumbing fixture specified including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components and finishes.
2. Wiring diagrams for field installed wiring of electrically operated units.

B. Product Data: Submit product data and installation instructions of each fixture, faucet, specialty, accessory and trim specified or shown on plumbing fixture schedule; clearly indicate rated capacities of selected models.

C. Shop Drawings: Submit rough-in drawings with brand names on each sheet and item. Detail dimensions, rough-in requirements, required clearances and methods of assembly of components and anchorages. Coordinate requirements with architectural casework shop drawings specified in Division 6 for fixtures installed in countertops and cabinets. Furnish templates for use in casework shop drawings.

D. Wiring Diagrams: Submit manufacturer electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed. Coordinate and provide matrix of mechanical and electrical requirements as specified in Division 22.

E. Color Charts: Coordinate fixture color with Architect and submit manufacturers standard color charts for cabinet finishes and fixture colors.

F. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured plumbing fixture, valve and trim. In addition to providing in the submittals, include this data, product data and shop drawings with operations and maintenance manuals.

G. Submit certification of compliance with specified performance verification requirements and IPC, NSF, ANSI, UL, and ASHRAE Standards.

1.5 QUALITY ASSURANCE

A. ADA Requirements: Comply with requirements of Americans with Disability Act. Provide Fixtures complying with ADA accessibility requirements.

B. Regulatory Requirements: Comply with requirements of ANSI Standard A117.1 “Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People” and Public Law 90 480 “Architectural Barriers Act, 1968” with respect to plumbing fixtures for the physically handicapped.

C. Regulatory Requirements: Comply with requirements of ATBCB (Architectural and Transportation Barriers Compliance Board) “Uniform Federal Accessibility Standards (UFAS) 1985 494 187” with respect to plumbing fixtures for the physically handicapped.

D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The terms “listed” and “labeled” shall be as defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NTRL) as defined in OSHA Regulation 1910.7.

E. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

F. Codes and Standards

1. Current Adopted Plumbing Code
2. NSF Standard 61: “Drinking Water System Components”
3. ASHRAE Standard 18: “Methods of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration”
4. ARI Standard 1010: “Self-Contained, Mechanically Refrigerated Drinking Water Coolers”
5. UL Standard 399: “Drinking Water Coolers”
6. Drinking Water Act – Current Edition
7. Department of Public Health and Environment Regulations
8. Cross- Connection Control Manual: Current Edition
9. ANSI Standard A117.1: “Standard on Accessible and Usable Buildings and Facilities”
10. Accessibility Guidelines and Standards of the United States Access Board
11. Current Appliance and Equipment Standards of the United States Department of Energy

G. Where fixtures are indicated on the architectural drawings and intended to be ADA Compliant, it shall be the sole responsibility for all manufacturers and/or suppliers to provide plumbing fixtures and related trim which meets the ADA requirements. Such indication may be shown by note on floor plans or schedules, by clearance dimensions or areas on the plans or other graphics or notes on elevations.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver plumbing fixtures in manufacturer’s protective packing, crating and covering.

B. Store plumbing fixtures on elevated platforms in a dry location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Water Closets:

    a. American Standard
    b. Kohler
    c. Zurn
    d. Toto

2. Lavatories:

    a. American Standard
    b. Kohler
    c. Zurn
    d. Toto

3. Stainless Steel Sinks:

    a. Elkay
    b. Just
    c. Moen

4. Showers:

    a. Best Bath
    b. Fiberglass Systems
    c. Aquatic
    d. Freedom
    e. Floreston
    f. Manstone
    g. Fiat
    h. Lasco
    i. Kohler
    j. Prefabricated Showers

5. Outlet Boxes:

    a. Guy Gray
    b. Symmons
    c. Sioux Chief

6. Toilet Seats:

    a. Bemis
    b. Beneke

c. Church
d. Kohler
e. Olsonite
f. Sperzel
g. American Standard

7. Flushometers:

a. Sloan
b. Zurn
c. American Standard
d. Kohler
e. Toto

8. Commercial/Industrial Cast Brass Faucets:

a. American Standard
b. Chicago Faucet
c. Delta Faucet
d. Kohler
e. Symmons
f. T&S Brass
g. Hydrotek
h. Elkay

9. Fixture Supplies, Stops, Traps:

a. McGuire
b. Brasscraft
c. Dearborn

10. Protective Pipe Covers:

a. McGuire
b. TruBro

11. Garbage Disposers:

a. In-Sink-Erator
b. Waste King

12. Fixture Carriers and Supports:

a. Josam
b. Smith (Jay R)
c. Wade
d. Zurn
e. Watts

2.2 PLUMBING FIXTURES, GENERAL

A. Provide plumbing fixtures and trim, fittings, other components and supports as specified. All fixtures to be lead free per NSF 61 App 6, AB1953.

B. Refer to schedule on drawings.

C. All fixtures to be white unless otherwise noted.

D. Provide a thermostatic mixing valve that meets ANSI Z358.1 requirements for emergency fixtures.

E. Provide a cane apron for non-high/low drinking fountains and water coolers shown to protrude into the walkway.

F. Water Closets:

1. Fixture Color: White unless specified otherwise. Coordinate with architectural
2. Action: Siphon jet
3. Rim: Elongated round front
4. Trim: All trim shall be chrome plated, cast brass, or copper tube. Plastics or metal alloy base type material will not be acceptable.
5. All ADA installation for operating handles shall meet ANSI 117.1 requirements.
6. Cast iron or red brass threaded nipples for wall hung fixture connections to carrier.
7. Provide fully glazed trapways. Partial glazing is not acceptable.

G. Lavatories

1. Material: Plastic formed or enameled steel lavatories are not acceptable.
2. Fixture Color: White, unless specified otherwise. Coordinate with architectural
3. Mounting: Lavatories specified or scheduled as wall hung shall be supported from floor mounted top and bottom bearing plate or concealed arm carrier. Wall mounted wood or metal blocking hangers will not be permitted. Counter mounting, self-rimming or composite countertop with integral bowl as specified or scheduled.
4. Faucet hold drilling: Drilling shall be provided by the fixture manufacturer to match the required fixture mounting and accessories specified by this and other sections of the plans and specifications. Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering lavatories.
5. Size and style of listed acceptable units shall match the specified or scheduled unit including appearance, shrouds, enclosures, soap depressions, front or rear overflows, flat slab rim, splash rack, shelf back side shields, etc.

H. Stainless Steel Sinks:

1. Material: Type 304, 18-gauge stainless steel
2. Fixture Color: No.4 satin finish for stainless steel. White, for enameled cast iron, unless specifically specified otherwise. Composites only as specified.
3. Mounting: Wall mounted and carrier mounted sinks shall be installed per manufacturer recommendations and instructions.
4. Faucet hole drillings shall match the faucet configuration and accessories specified in the mechanical and architectural documents, i.e., dishwasher air gaps, liquid dispensers, remote drain operators, eye washes, etc., when mounted in the sink back ledge. NOTE: Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering sinks.
5. Stainless steel sinks to be sound deadened with undercoating.

I. Prefabricated Showers:

1. Color: White, unless otherwise specified
2. Provide center drain with a brass or stainless-steel shower drain cover.
3. Floor shall have a slip resistant, textured bottom.
4. Provide reinforcement of shower where grab bars are specified.

2.3 FAUCETS

A. Faucets, General: Unless otherwise specified, provide faucets that are cast brass with polished chrome plated finish.

B. Alternate faucet controls, i.e., self-closing, knee operated, foot operated, etc. shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.

C. Lavatory Trim:

1. All lavatory faucets shall be provided with 1/4 -turn handles, laminar flow controls in lieu of aerators.
2. All lavatory faucets shall be provided with ceramic disc cartridges.
3. Faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district
4. Infrared faucets must be provided with integral stops.

D. Sink Trim

1. All sink faucets shall be provided with 1/4 turn handles, laminar flow controls in lieu of aerators.
2. All sink faucets shall be provided with ceramic disc cartridges.
3. Alternate faucet controls, i.e., self-closing, knee operated, foot operated, etc., shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
4. All sink faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district. Types include hand, foot, knee, infra-red or heat sensing type operations.
5. Infrared faucets must be provided with integral stops.

E. Shower Trim

1. Shower valves shall be balanced-pressure type, ASSE 1016/ASME A112.1016.
2. The shower control valve shall limit the maximum water supply temperature to not exceed 120°F.
3. Inlets and Outlet: 1/2"
4. Integral service stop

2.4 FITTINGS, EXCEPT FAUCETS

A. Provide 1/4 turn convertible angle stops whether angle or straight for all applications.

B. Fittings, General: Unless otherwise specified, provide fittings fabricated of brass with a polished chrome plated finish.

C. Lavatory Supplies and Stops: 1/4 turn ball angle stop having 1/2" NPS inlet with wall flange and 3/8” by 12” flexible chrome plated tubing riser outlet.

D. Lavatory Traps: Cast Brass, 1-1/4” NPS adjustable P-trap with clean out, 17-gauge tubular waste to wall and wall flange.

E. Sink Supplies and Stops: 1/4 turn ball angle stop having 1/2" NPS inlet with wall flange and 1/2" by 12” flexible chrome plated tubing riser outlet.

F. Sink Traps and Garbage Disposer: Cast Brass, 1-1/2” NPS adjustable P-trap with cleanout, 17- gauge tubular waste to wall and wall flange.

G. Sink Continuous Waste: Polished chrome plated, tubular brass, 1-1/2”, 17 gauge, with brass nuts on slip inlets and of configurations indicated.

H. Supply and drain plumbing service fittings not listed above shall be as specified and as scheduled.

I. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.

J. Escutcheons: Polished chrome plated, sheet steel wall flange with friction clips.

K. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing in fittings.

L. Provide fittings specified as part of a fixture description in lieu of fitting requirements above.

M. Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of fixture.

N. ADA accessible Lavatories and Sinks: Provide white, molded antimicrobial vinyl cover for stops supplies, trap, and tailpiece. Pipe coverings shall comply with ASME A112.18.9 or ASTM C1822.

O. Stops and Supplies for Water Closets: Polished, chrome-plated, brass ball and stem, loose key, angle stop having 1/2" inlet and 3/8” O.D. x 12; long chrome plated copper supply riser or braided stainless steel flexible tubing; outlet with collar, wall flange and escutcheon. Quantity to match trim specified. Deliver all handles to Owner.

2.5 FLUSHOMETERS

A. Provide flushometers compatible with fixtures with features and of consumption indicated.

B. Construction: Cast brass body, brass or copper pie or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker, and brass lever handle actuation except where other variations are specified. Type shall be diaphragm operation except where other type is specified.

C. Finish: Exposed metal parts shall be polished chrome plated except components installed in a concealed location may be rough brass or unfinished.

D. Flushometers: Furnish with the following features:

1. Non hold open feature
2. ADA actuator on handicapped fixtures mounted on wide side of fixture.
3. Seat bumper on stop
4. Bedpan washer diverter valve, spray head and support (where specified)
5. Trap primer connection
6. Furnish flushometers with factory set or field adjusted maximum water consumption to match fixture.

2.6 TOILET SEATS

A. General: Provide toilet seats compatible with water closets of type, color and features indicated.

B. Toilet Seats: Extra heavy-duty, 500lb static weight load, commercial/industrial type, elongated, open front, solid plastic, with stainless steel hinge post and check hinge.

C. Provide permanent anti-microbial treatment by the manufacturer.

2.7 PLUMBING FIXTURE SUPPORTS

A. Supports: ASME A112.6.1M, categories and types as required for wall hanging fixtures specified and wall reinforcement.

B. Support categories are:

1. Carriers: Supports for wall hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall hanging water closets.
2. Chari Carriers: Supports with steel pipe uprights for wall hanging lavatories and fixtures. Urinal chair carriers shall have bearing plates.
3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall hanging fixtures.
4. Reinforcement: 2” by 4” wood blocking between studs or 1/4" by 6” steel plates attached to studs in wall construction to secure floor mounted and special fixtures to wall.

C. Support Types: Provide support of category specified of type having features required to match fixture.

D. Provide supports specified as part of fixture description in lieu of category and type requirements above.

2.8 GARBAGE DISPOSERS

A. Units shall be factory assembled and tested, listed, and labeled in compliance with UL Standards.

B. Mounting: Mount and install per the manufacturer’s recommendation

C. Rough in dimension: See architectural drawings for specific installation placement dimensions and required mounting heights.

D. Waste: Chrome plated tailpiece with trap. See “Fittings, Trim and Accessories” for size.

E. Electrical Characteristics: Provide 3 prong power lead in cord. Coordinate electrical requirements with Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Install plumbing fixtures and specified components in accordance with designations and locations indicated on drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated and of type required.

1. Carriers for following fixtures

a. Wall hanging water closets
b. Wall hanging fixtures supported from wall construction

2. Chair carriers for the following fixtures

a. Wall hanging lavatories and sinks
b. Wall hanging drinking fountains and electric water coolers

3. Heavy duty chair carriers for the following fixtures

a. Accessible lavatories
b. Fixtures where specified

4. Reinforcement for the following fixtures

a. Fixtures required to be secured to wall

3.3 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb in accordance with fixture manufacturers written installation instructions, rouging in drawings and referenced standards.

B. Install floor mounted, floor outlet water closets with closet flanges and gasket seals.

C. Install wall hanging, back outlet water closets and urinals with gasket seals.

D. All wall hung fixtures shall be supported from the building structure with floor mounted carriers. Do not support from walls.

E. Fasten floor mounted fixtures and special fixtures having holes for securing fixture to wall construction to reinforcement built into walls.

F. Fasten wall mounted fittings to reinforcement built into walls.

G. Fasten counter mounting type plumbing fixtures to casework.

H. Secure supplies behind wall or within wall pipe space, providing rigid installation.

I. Install trap on fixture outlet except for fixtures having integral trap.

J. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

K. Seal fixtures to walls, floors and counters using a sanitary type, one part, mildew resistant, silicone. Match sealant color to fixture color.

L. Flush valves shall be anchored behind walls to eliminate push-pull, horizontal or vertical movement.

M. All flush valves shall have a properly sized water hammer arrestor.

N. Set prefabricated showers, shower receptors and mop basins in a level bed of cement grout; material shall be as recommended by manufacturer or as specified by Architect.

O. Install fixture water stop valves in accessible locations. Hot water supply shall always be located on left side of fixture and the cold supply shall always be located on the right side of fixture.

P. Provide cleanouts as shown on drawings or per the applicable Plumbing Code

Q. Chrome plated cap nuts for wall hung fixtures shall be installed with strap wrench to prevent marring.

R. Fixtures shall be product of one manufacturer and must be manufactured in the USA per Division 22.

S. Solidly attach floor mounted water closets to floor flanges.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other sections of Division 22. The drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping connections between plumbing fixtures and dipping systems and plumbing equipment specified in other sections of Division 22.
2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.5 ADA ACCESSIBILITY

A. Review Mechanical and Architectural drawings to determine fixtures requiring AD Accessibility. Notify Architect/Engineer of any physical conflicts preventing full dimensional compliance prior to beginning work.

B. Comply with the installation requirements of ANSI A117.1 and “Accessibility Guidelines and Standards of the United States Access Board” with respect to plumbing fixtures for the physically handicapped. Arrange flush valve/flush tank handles with proper orientation to meet ADA requirements.

3.6 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.7 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at electric water coolers, faucets, shower valves and flushometers having controls to provide proper flow and stream.

C. Replace washers of leaking and dripping faucets and stops.

D. Clean fixtures, fittings and spout and drain strainers with manufacturers recommended cleaning methods and materials.

E. Review the data in Operating and maintenance Manuals. Refer to Division 1 Section “Project Closeout”.

3.8 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities except when approved in writing by the Owner.

C. Refer to Plumbing Fixture Schedule on drawings for specified water flow rates for each fixture type on this project.

D. Lower water flow rates are permissible.

E. All plumbing fixtures shall be of water conservation design per the current water conservation measures. As a minimum, provide devices to restrict water flow as follows unless scheduled otherwise.

F.

G. Plumbing Fixture or Fixture Fitting	H. Maximum Flow Rate or Quantity
I. Lavatory, Private	J. 2.2. gpm at 60 psi
K. Lavatory, Public (other than metering)	L. 0.5 gpm at 60 psi
M. Showerhead	N. 2.5 gpm at 80 psi
O. Sink Faucet	P. 2.2 gpm at 60 psi
Q. Water Closet	R. 1.6 gallons per flushing cycle

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.

C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY:

A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.3 MECHANICAL INSTALLATIONS:

A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.

D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to

conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.

G. Verify all dimensions by field measurements.

H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.

I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

K. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.

M. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

N. In general, all “static” piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all mechanical equipment, opening/closing of all valves, draining/refilling all mechanical systems and operating/verifying the operation of all mechanical systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.4 coordination:

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, <u>in all areas</u>. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contact sum. **The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.**

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21, 22, and 23 Contractors.
2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.
3. Furnish building equipment (elevator, food service, medical, technology, etc) information to Div 21, 22, and 23 contractors.

C. Existing Conditions:

1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing 3D drawing.
2. Contractor shall be responsible for showing all existing conditions on the 3D coordination drawings.
3. Provide proper coordination of mechanical work with existing conditions.
4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 coordination with other divisions:

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains
4. Plumbing vent piping
5. Low pressure ductwork and air devices.
6. Electrical and communication conduits, raceways and cabletray.
7. Domestic hot and cold water
8. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
9. DDC control wiring and other low voltage systems.
10. Fire alarm systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.

G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.6 design work required by contractor

A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of coordination shall be the complete responsibility of the Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
2. Any system not fully detailed
3. Fire protection systems
4. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents or catalogued by the manufacturer.
5. Temperature controls systems
6. Refrigeration systems
7. Seismic restraint systems

D. Design Limitations:

1. The Contractor shall not modify the Engineers design intent in any way.
2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
3. The Contractor shall conform to the SMACNA Duct Construction Standards when modifying the ductwork layout to avoid collisions.
4. Back-to-back 90° fittings on duct system shall not be installed under any circumstance.
5. Bull nosed tees on piping systems shall not be installed under any circumstance.
6. Internal tie rods shall not be used. Brace duct externally.

1.7 PROJECT CONDITIONS:

A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

B. Field verify all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.

G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.

H. Coordinate all services shutdown with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.

I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.8 SAFETY

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

A. Refer to Division 1.

B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.

C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies. **See code declaration information on the drawings**

D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

E. The handling, removal and disposal of regulated refrigerants and other materials shall be in accordance with U.S. EPA, state and local regulations.

F. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.

G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.11 PERMITS AND FEES

A. Refer to Division 1.

B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

B. All systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.13 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.

B. Use of Permanent Building Equipment for Temporary Heating or Cooling: Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. Steam and hydronic systems shall be flushed and chemically treated. Ductwork and air moving equipment shall be cleaned to an “AS New” condition. All filters required for the construction period shall be equivalent to the filters required for the final installation. All filters shall be replaced at the time of substantial completion. The guarantee period of all equipment used shall not start until the equipment is turned over to the Owner for his use. A written record of maintenance, operation and servicing shall be turned over to the owner prior to final acceptance.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and Division 1.

B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where

substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.

1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.

D. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:

1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment’s clearance requirements.
2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
3. Inclusion in the bid of any applicable costs for changes in prime bidder’s and their sub bidders’ work required to accommodate the utilization of the comparable product.
4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.15 MECHANICAL SUBMITTALS

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:

a. Product
b. Plan Code (if applicable)
c. Specification Section
d. Manufacturer and Model Number

7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder or as required by Division 1.

B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If the contractor proposes alternates or substitutions in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards.

D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.

E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21, 22, and 23 Sections.

F. The Design Professional’s review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

G. The Design Professional’s review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional’s judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for

subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

K. The contractor shall cloud all changes made on submittals that are marked “Revise and Resubmit.”

L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

A. Product Listing:

1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.

    a. Provide all information requested.
    b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."

2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
3. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.

    a. Provide products which are compatible within systems and other connected items.

B. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

    a. Sizes.
    b. Weights.
    c. Speeds.
    d. Capacities.
    e. Piping and electrical connection sizes and locations.
    f. Statements of compliance with the required standards and regulations.
    g. Performance data.
    h. Manufacturer's specifications.

C. Shop Drawings:

1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8”-1'-0", unless otherwise noted.

    a. Show clearance dimensions at critical locations.
    b. Show dimensions of spaces required for operation and maintenance.
    c. Show interfaces with other work, including structural support.

D. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

E. Operation and Maintenance Data: See separate paragraph of this specification section.

F. Software Licenses: Provide documentation of ownership under the owner’s corporate name (coordinate with owner’s representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

G. Record Drawings: See separate paragraph of this specification section.

1.17 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.

E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

F. Provide factory-applied plastic endcaps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.

G. Protect stored ductwork, pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.

I. Protect sheet metal ductwork and fittings. Elevate and store above grade and cover ends with waterproof wrapping.

1.18 DEMOLITION:

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. During the demolition phase of this contract, it is the responsibility of this Contractor to carefully remove existing equipment, piping or ductwork and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.

1. Return existing thermostats to the owner.
2. Return all demolished control valves and devices to the Owner.

C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

D. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.

1.19 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

B. Refer to Division 1.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.

F. Perform cutting, fitting and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.

4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.

G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, and other mechanical items made obsolete by the new work.

H. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.

J. Locate identify and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Cover openings in ductwork to remain. Protect equipment and systems to remain.

1.20 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

C. Work through all coordination before rough-in begins.

1.21 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

C. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 8 for access door specification and Division 23 for duct access door requirements.

D. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

E. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

F. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

G. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.

H. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, sensors, motors, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.22 BELTS, SHEAVES, IMPELLERS

A. The Mechanical Contractor shall coordinate with the Test and Balance Contractor and supply correctly sized drive belts, sheaves, and trimmed impellers.

1.23 NAMEPLATE DATA

A. Provide permanent operational data nameplate, refer to the section on Mechanical Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1.24 LUBRICATION OF EQUIPMENT

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Contractor shall properly lubricate all mechanical pieces of equipment which he provided before turning the building over to the Owner. He shall attach a linen tag or heavy duty shipping tag on the piece of equipment showing the date of lubrication and the type and brand of lubricant used.

C. Furnish the Engineer with a typewritten list included in the O&M manuals of each item lubricated and type of lubricant used, no later than two (2) weeks before completion of the project, or at time of acceptance by the Owner of a portion of the building and the mechanical systems involved.

1.25 CLEANING

A. Refer to Division 1.

B. Refer to Division 23, "TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

1.26 RECORD DOCUMENTS

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping or ductwork relocated more than 1foot-0inches from where shown on the drawings.

D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.

F. Reference to change order numbers, RFIs, etc., are not acceptable as-builts.

G. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:

1. Red shall indicate new items, deviations and routing.
2. Green shall indicate items removed or deleted.
3. Blue shall be used for relevant notes and descriptions.

H. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

I. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.27 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1.

B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).

C. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.

D. In addition to the information required by Division 1 for Maintenance Data, include the following information:

1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.

2. Description of mechanical equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
3. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
5. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
6. Manufacturer's service manuals for all mechanical equipment provided under this contract.
7. Include the valve tag list.
8. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
9. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
10. Complete recommended spare parts list.
11. Mechanical System and Equipment Warranties.
12. Copies of all test reports shall be included in the manuals.
13. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
14. Final schedule of values with all mechanical change order costs included and identified.
15. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.

E. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.28 PROJECT CLOSEOUT List

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

B. The Contractor shall be responsible for the following Mechanical Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.29 WARRANTIES

A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 21, 22, and 23, into or include the Operating and Maintenance Manuals.

C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.30 CONSTRUCTION REQUIREMENTS

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1. Up to date record drawings.
2. Submittals
3. Site observation reports with current status of all action items.
4. Test results; including recorded values, procedures, and other findings.
5. Outage information.

1.31 MECHANICAL SUBMITTAL CHECKLIST

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
230500	Final Schedule Of Values			X		X			
230500	Equipment Warranties			X					
230500	O&M Manuals		X	X		X			X
230500	Record Drawings	X	X	X					
230507	Motors, Drives, Motor Controllers	X	X	X					
230509	Mechanical Fire Stopping	X	X	X				X	
230510	Basic Piping Materials And Methods		X	X	X	X			
230529	Hangers and Supports	X	X	X					
230548	Vibration and Seismic Control	X	X	X	X	X			
230553	Mechanical Identification		X	X					X
230593	Testing ,Adjusting and Balancing	X		X	X	X			
230700	Mechanical Insulation		X	X					
230993	Sequence Of Operation			X					
232316	Refrigeration Specialties		X	X					
233113	Metal Ducts	X	X	X	X	X			
233116	Non-Metal Ductwork	X	X	X	X	X	X		
233300	Air Duct Accessories		X	X		X			X
233400	HVAC Fans		X	X				X	X
233713	Diffusers, Registers & Grilles		X	X					X

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
238000	Decentralized HVAC Equipment		X	X					X
238126	Ductless Split Systems		X	X					

Notes: [1] For Starters and Variable Frequency Drives
[2] Requires Review & Approval of calibrated balance valves from T & B Contractor
[3] See Specific Specification Section for Test & Certification Requirements

1.32 mechanical EQUIPMENT CONNECTION SCHEDULES

A. Mechanical Equipment:

1. Refer to Mechanical Equipment Schedules on the drawings.
2. All equipment motors and control shall be furnished, set in place, and wired in accordance with the schedule coordinated by the contractor and submitted prior to bid. The exact furnishing and installation of the equipment is left to the Contractors involved and manufacturers installation instructions. Contractor should note that the intent of this schedule is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
1. Mechanical Equipment Motors			
2. Special Equipment (i.e., elevators, etc.) a. Motors b. Magnetic Motor Starters c. Disconnect Switches d. Thermal OL Switches e. Manual Operating Switches			
3. Motor Starters, combination motor starter/disconnect and Variable Frequency Drives a. Automatically controlled, with or without HOA switches. b. Manually controlled. c. Starters integral with motor control center including control relays and transformers. d. Combination Starter/Disconnects			
4. Pushbutton stations, pilot lights			

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
5. Disconnect switches, thermal overload switches, manual operating switches.			
6. Multi-speed switches			
7. Control relays, transformers.			
8. Non-load voltage control items.			
9. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			
10. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.			
11. Control circuit outlets			
a. Load voltage control items such as line voltage thermostats not connected to control panel systems.			
b. Non-load voltage control items.			
c. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			
d. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.			
e. Control circuit outlets			
12. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			
13. Fire protection controls (Including flow switches)			
14. Duct smoke detectors, including relays for fan shutdown.			
15. Temperature Control Panel			
16. Interlocks			

G = General, Division 13 or 14
M = Mechanical, Division 23
E = Electrical, Division 26
V = Vendor or Factory – Installed wiring

END OF SECTION 230500

SECTION 230510 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Refer to Division 1 and Section 230500 “Common Work Results for Mechanical” for administrative and procedural requirements for submittals.

B. Product Data: Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.

C. Welding Certifications: Submit reports as required for piping work.

D. Brazing Certifications: Submit reports as required for piping work.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

C. Welding procedures and testing shall comply with the latest revisions of the applicable sections for B31, of the ANSI/ASME standard codes for pressure piping, noted as follows: B31.1 – Power Piping Code / B31.2 - Fuel Gas Piping Code / B3.1.3 – Process Piping/ B31.5 - Refrigeration Piping / B31.9 - Building Service Piping Code.

D. Before any welding is performed, the contractor shall submit to the Architect/Engineer, or his authorized representative, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests and his Welding Procedure Specification together with the Procedure Qualification Record as required by ASME Boiler and Pressure Vessel Code.

E. Each manufacturer or contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.

F. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

PART 2 - PRODUCTS

2.1 GENERAL

A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or

class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.2 STEEL PIPES AND PIPE FITTINGS

2.3 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88; Type K or L as indicated for each service; hard-drawn temper, except as otherwise indicated.

B. ACR Copper Tube: ASTM B 280.

C. Cast-Copper Solder-Joint Fittings: ANSI B16.18.

D. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

E. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).

F. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.

G. Cast-Copper Flared Tube Fittings: ANSI B16.26.

H. Bronze Pipe Flanges/Fittings: ANSI B16.24 (Class 150 and 300).

I. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.4 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Soldering Materials: All soldering materials shall be lead free.

1. 95-5 Tin-Antimony: ASTM B 32, Grade 95TA. Melting Range 450-470 degrees F.
2. Silver-Tin Alloy: Fed. Spec. QQ-S-571E, NSFC2. Melting Range 430 to 530 degrees F.
3. Flux: All flux shall be lead free, water soluble, and compatible with the solder and the materials being joined. ASTM B813-93.

C. Brazing Materials: Except as otherwise indicated, provide brazing materials to comply with installation requirements.

1. Comply with AWS A5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

    a. Copper phosphorus -Bcup-5, 15 percent solder content, melting range 1190 to 1480 degrees F.
    b. Silver - BAg-36, 45 percent silver, cadmium-free. Melting range 1195 to 1265 degrees F.

D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated. **–**NOTE: use spiral wound gaskets for steam with grade 5 bolts.

E. Pipe Thread Sealant Material: Except as otherwise indicated, provide all pipe threads with the sealant material as recommended by the manufacturer for the service.

1. Manufacturer: Subject to compliance with requirements, provide piping thread sealant material of the following:

    a. The Rectorseal Corporation

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, and original design, and the referenced standards.

B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

1. Comply with ANSI B31 Code for Pressure Piping.
2. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.
3. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
4. Use fittings for all changes in direction and all branch connections.
5. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

6. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
7. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
8. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
9. Install drains in pressure pipe systems at all low points in mains, risers, and branch lines consisting of a tee fitting, ¾ inch ball valve, and short ¾ inch threaded end nipple and cap with chain.
10. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
11. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Division 23, Sections 230518 and 23 05 09 for materials.
12. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals (See Section 230518). Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
13. Anchor piping to ensure proper direction of expansion and contraction.
14. Coordinate foundation and all other structural penetrations with structural engineer.

B. Refrigerant Piping:

1. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration."
2. Install piping in as short and direct arrangement as possible to minimize pressure drop.
3. Install piping for minimum number of joints using as few elbows and other fittings as possible.
4. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
5. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
6. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

    a. Do not install insulation until system testing has been completed and all leaks have been eliminated.

7. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
8. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
9. Slope refrigerant piping as follows:

    a. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
    b. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
    c. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
    d. Liquid lines may be installed level.

C. Condensante Drain Piping:

1. Condensate drain piping from air conditioning unit coil condensate drain pan shall be of the sizes shown on the drawings.

3.3 PIPING SYSTEM JOINTS

A. General: Provide joints of type indicated in each piping system.

B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

C. Braze copper tube-and-fitting joints in accordance with ASME B31.

D. Solder copper tube-and-fitting joints with silver solder or 95-5 tin-antimony. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

E. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31. Provide weld-o-let fittings for two pipe sizes less than main pipe size.

F. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Weld pipe joints only when ambient temperature is above 0 degrees F (-18 degrees C) where possible.
2. Bevel pipe ends at a 37.5 degrees angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
3. Use pipe clamps or tack-weld joints with 1-inch-long welds; 4 welds for pipe sizes to 10 inches, 8 welds for pipe sizes 12 inch to 20 inch.
4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
5. Do not weld-out piping system imperfections by tack- welding procedures; refabricate to comply with requirements.

G. Weld pipe joints of steel water pipe in accordance with AWWA C206.

H. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

I. Copper Press Fitting Joints: Use proprietary crimping tool and follow joining procedure recommended by fitting manufacturer.

J. Refrigerant Piping:

1. Ream ends of pipe and tubes and remove burrs
2. Fill pipe with dry nitrogen and purge during brazing to prevent scale buildup
3. Braze joint per AWS Brazing handbook

    a. Use Type BCuP (copper phosphorus) alloy for copper to copper joints
    b. Use BAg (cadmium silver) to join copper to bronze or steel

4. Leak Test:

   a. Comply with ASME 331-5 Chapter VI
   b. Test high and low side piping separately

      1) Fill system with dry nitrogen to test pressure
      2) Test joints and fittings with leak detector at all joints
      3) Remove leaking joints with new materials and retest. Once test is correct and system holds pressure for 24 hours evacuate to 500 micrometers and hold for 12 hours. Break vacuum with nitrogen and re-evacuate to 500 micrometers and hold for 2 hours. Break vacuum with refrigerant and charge per manufacturer requirements.

3.4 PIPING APPLICATION

A. Equipment Drains and Overflows, Cooling Coil Drain Pan Piping, Condensate Drains:

   1. Type "M" or "DWV" copper.

B. Refrigerant Piping:

   1. Type ACR copper, cleaned, dehydrated and capped at the factory. Wrought copper fittings, brazed joints with nitrogen purge.

3.5 PIPING TESTS

A. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible and remove control devices before testing. Test each section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

B. Test all piping systems as specified. Correct leaks by remaking joints. Remove equipment not able to withstand test procedure during test.

C. Work to be installed shall remain uncovered until the required tests have been completed.

D. Piping which is to be concealed shall be tested before being permanently enclosed.

E. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.

F. Give a minimum of twenty-four hours' notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of representative of owner, agency having jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.

G. Contractor shall obtain certificates of approval, acceptance and compliance with regulations of agencies having jurisdiction. Work shall not be considered complete until such certificates have been delivered by the Engineer to the Owner.

H. All costs involved in these tests shall be borne by Contractor.

I. System Tests

1. Test all refrigerant piping systems with nitrogen at 300 psig pressure on high side of system, and at 150 psig pressure on low side of system. Maintain pressure without loss for a time period of not less than 4 hours. After test has been completed, the piping shall be evacuated by means of a vacuum pump for a period of not less than 24 hours or until system has been completely evacuated.
2. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
3. Drain test water from piping systems after testing and repair work has been completed.

3.6 ADJUSTING AND CLEANING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.

B. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

C. Chemical Treatment: Provide hydronic systems with a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing. Refer to 232500.

3.7 SYSTEM START UP

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position. Close coil bypass valves.
2. Remove and clean strainers.
3. Check pump for proper rotation and proper wiring and remove startup screens.
4. Set automatic fill valves for required system pressure.
5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Check operation of automatic bypass valve.
8. Check and set operating temperature of boilers, chillers, and cooling towers to design requirements.
9. Lubricate motors and bearings.

END OF SECTION 230510

SECTION 230529 – HANGERS AND SUPPORTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Regulatory Requirements: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. Duct Hangers: SMACNA Duct Manuals
3. MSS Standard Compliance:

    a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.

4. NFPA Compliance: NFPA 99 shall be used for medical gas systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Pipe Hangers and Supports:

    a. B-Line Systems Inc.

b. ANVIL International
c. PHD Manufacturing, Inc.
d. Unistrut Metal Framing Systems
e. Erico
f. Grinnell

2. Duct Cable Hangers and Supports:

a. Gripple Inc.
b. Ductmate Industries
c. Grip Lock Systems

3. Saddles, Shield and Thermal Shield Inserts:

a. ANVIL International
b. Pipe Shields, Inc.
c. B-Line
d. Snapp Itz
e. Erico
f. Value Engineered Products, Inc.
g. Grinnell

4. Roof Equipment Supports:

a. Custom Curb, Inc.
b. Pate Co.
c. Thybar Corp.
d. Vent Products, Inc.
e. Miro
f. Bigfoot

2.2 PIPE HANGERS & SUPPORTS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-69.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. Comply with MSS_SP58 types 1 through 58
4. Oversize hanger for insulated piping

B. Adjustable Clevis Hanger: MSS Type.

1. Steel and Copper Pipe, size 3/8" thru 30", Type 1.
2. Non-insulated Copper Pipe, size 1/2" thru 4", Type 1. (PVC Coated)
3. Insulated pipe oversize hanger to accommodate insulation.

C. Adjustable Swivel Ring for Non-insulated Pipe: MSS Type .

1. Steel Pipe, size 1/2" thru 8", Type 7, 9 or 10.
2. Copper Pipe, size 1/2" thru 4", Type 7 (PVC Coated)
3. Insulated pipe oversize hanger to accommodate insulation

D. Pipe Clamps: MSS Type.

1. Steel Pipe, size 3/4" thru 24", Type 8, 3 or 42.
2. Copper Pipe, size 1/2" thru 4", Type 8, 3 or 42 (PVC Coated).

E. U Bolts: MSS Type .

1. Steel Pipe, size 1/2" thru 30" Type 24
2. Copper Pipe, size 1/2" thru 8", Type 24 (PVC Coated).

F. Straps: MSS Type 26.

G. Pipe Stanchion Saddle: MSS Type 37.

H. Yoke & Roller Hanger: MSS Type 43

I. Hanger Rods: Continuous threaded steel, sizes as specified.

J. Hangers:

1. Hot Pipes:

a. 1/2" through 1-1/2": Adjustable wrought steel ring.
b. 2" through 5": Adjustable wrought steel clevis.
c. 6" and Over: Adjustable steel yoke and cast-iron roll.

2. Cold Pipes:

a. 1/2" through 1-1/2": Adjustable wrought steel ring.
b. 2" and Over: Adjustable wrought steel clevis.

3. Multiple or Trapeze: Structural steel channel (with web vertical and engineered for the specific applications), with welded spacers and hanger rods. Provide cast iron roll and base plate for hot pipe sizes six inches and over. Provide hanger rods one size larger than for largest pipe in trapeze. If the deflection at center of trapeze exceeds 1/360 of the distance between the end hangers, install an additional hanger at mid-span or use a larger channel.

K. Wall Supports for Horizontal Steel Pipe:

1. ½ inch through 4inches: Offset or straight j-hook.
2. 4 inches and Over: Welded steel bracket Type 31, 32 or 33 and wrought steel clamp. Provide adjustable steel yoke and cast-iron roll Type 44 for hot pipe 200 degrees F and over and for sizes six inches and over.

L. Supports for Vertical Pipe: Steel riser clamp. Type 8 or 42.

M. Upper Attachments:

1. For attaching hanger rods to structural steel I-beams:

a. Provide adjustable beam clamp, MSS-Type 20, 21, 28, 29, or 30. Attach to bottom flange of beam.

2. For attaching hanger rods to bar joists:

a. When bottom chord is constructed of structural steel angles, provide square washer. Place hanger rod between backs of the two angles and support with the washer and dual locking nuts on top of the angles. Spot weld washer to angles.
b. When bottom chord is constructed of round bars, provide Elcen No. 137 bar joint washer or equal.

2.3 CONCRETE INSERTS AND ANCHORS

A. Inserts: Case shall be of galvanized carbon steel with square threaded concrete insert nut for hanger rod connection; top lugs for reinforcing rods, nail holes for attaching to forms. This type of upper attachment is to be used for all areas having poured in place concrete construction.

1. Size inserts to suit threaded hanger rods.

B. Provide fasteners attached to concrete ceilings that are vibration and shock resistant. Provide hangers for piping attached to concrete construction with one of the following types.

1. Concrete insert per MSS SP 69, Type 18.
2. Powder driven fasteners subject to approval of Architect and Structural Engineer. Each fastener shall be capable of holding a test load of 1000 pounds whereas the actual load shall not exceed 50 pounds.
3. Self-drilling expansion shields. The load applied shall not exceed one-fourth the proof test load required.
4. Machine bolt expansion anchor. The load applied shall not exceed one-fourth the proof test load required.

C. Anchors: Carbon steel, zinc plated and coated with a clear chromate finish. Installation shall be in holes drilled with carbide-tipped drill bits or by use of self-drilling anchors.

1. Provide anchors suitable for the location of installation and designed to withstand all forces and movements acting in the anchor. Manufacture pipe anchors in accordance with MSS SP 69. Provide a safety factor of four for the anchor installation.

2.4 SADDLES AND THERMAL SHIELD INSERTS:

A. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

B. Protection Shields: MSS Type 40; 180 degrees arc, galvanized steel, minimum 12 inches long, to prevent crushing of insulation. Provide solid insert on 4”and larger to prevent crushing insulation.

C. Thermal Shield Inserts: Provide 100-psi minimum compressive strength, waterproof, asbestos free calcium silicate, encased with a sheet metal enclosure. Insert and shield shall cover the entire circumference or the bottom half circumference of the pipe as required by Part 3 of this Specification and shall be of length recommended by the manufacturer for pipe size and thickness of insulation. For cold piping, calcium silicate shall extend beyond the sheet metal shield to allow overlap of the vapor barrier. Where piping 4 inches and larger is supported on trapeze or pipe rollers, provide double thickness shields. For piping 12 inches and over, provide 600 psi calcium silicate structural insert.

2.5 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

D. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.6 ROOF EQUIPMENT SUPPORTS

A. General requirements for pipe stands: Shop or factory fabricated assemblies made of manufactured corrosion resistant components.

B. Roof Mounted Equipment Stands

1. Elevated mechanical equipment support constructed of galvanized Unistrut bars with minimum 12x2-1/2x18gametal planks support deck, bolted angle bracing between vertical and horizontal members, polycarbonate, molded bases with roof deck support pads to protect roofing. Design to not exceed 3 psi to roof surface and sized by manufacturer to resist overturning of equipment by wind. Size base to not exceed load listed by manufacturer height to be minimum 8” above roof unless noted otherwise on drawing. Similar to MIRO 6 HD or Bigfoot.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified. Provide Shop Drawing showing method and support locations from structure.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments within concrete or on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. Existing Construction:

1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod. Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on field fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

C. Support fire-water piping independently from other piping systems.

D. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers are not acceptable.

E. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, to facilitate action of expansion joints, expansion loops, expansion bends and similar units and within 1'-0" of each horizontal elbow.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.

H. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Saddles: Install Protection saddles where supported by pipe rollers. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install galvanized steel protection shields, on all insulated piping 2 inches and less, except where required to be clamped. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "Zip Strips".

I. Install horizontal hydronic and steam piping with the following minimum rod sizes and maximum spacing:

SIZE (NPS)	MAX. SPAN IN FEET		MIN. ROD SIZE-INCHES
	Steel Piping	Copper Tubing	
3/4 to 1	7	6	3/8
1-1/2	9	8	3/8
2	10	8	3/8
3	12	8	1/2
4	12	8	5/8
5	12	8	5/8
6	12	8	3/4
8	12	-	7/8
10	12	-	7/8
12	12	-	7/8
Vertical – All Sizes	15	10	-

J. Pex and PP Pipe

1. Maximum horizontal spacing: 32” for 1” and smaller
2. Maximum vertical spacing: 10 foot with midpoint pipe guides.

K. Place a hanger within one foot of each horizontal elbow.

L. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.

M. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.

N. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers. Provide rubber oversized inserts on pipe clamps to allow movement.

O. Where practical, support riser piping independently of connected horizontal piping.

P. Support steam supply and condensate return pipe runs on adjustable roller hangers.

Q. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.

R. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:

1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.

2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than 6 inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any 50 successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.
3. Hangers for piping and ducts shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members with approval of structural engineer. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

S. Prevent copper tubes from making contact with steel brackets/hangers using fire retardant poly inserts or other dielectric material. Duct tape is not allowed.

3.5 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31.9, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping. Provide shop drawing for review by Engineer.

3.6 SHEET METAL DUCT HANGERS AND SUPPORTS

A. Provide in accordance with SMACNA HVAC duct construction standards.

B. Cable duct support systems:

1. Type ZA2 Zinc housing with stainless steel spring.
2. Galvanized high tensile steel cable provided by the same manufacturer as the fastener system.
3. Select hangers and cables for a minimum of 5:1 working load safety factor.
4. Cable duct support systems shall not be used in chlorinated or swimming pool environments.
5. Provide 316 stainless steel fastener and cable when used for support of stainless steel or aluminum ductwork.

C. Additional Hanger Requirements:

1. 2" to 24" from flexible connections of fans.
2. 2" to 24" from the outlets or flexible connections of VAV control units or mixing boxes.
3. 12" to 36" from the main duct to the first hanger of long branch ducts.
4. 2" to 12" from the ends of all branch ducts and linear diffuser plenums.
5. 2" to 24" from fire damper break-away joints.

6. Hangers at throat and heal of round or square elbows 48" or greater in diameter or width.

3.7 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

C. Concrete bases for the mechanical equipment indoors or outdoors will be provided by the General Contractor only if shown on the architectural or structural drawings. Otherwise, all bases shall be provided by this Contractor.

D. This Contractor shall be responsible for the proper size and location of all bases and shall furnish all required anchor bolts and sleeves. If bases are provided by the General Contractor, furnish him with templates showing the bolt locations.

E. Equipment shall be secured to the bases with anchor bolts of ample size. Bolts shall have bottom plates and pipe sleeves and shall be securely imbedded in the concrete. All machinery shall be grouted under the entire bearing surface. After grout has set, all wedges, shims and jack bolts shall be removed and the space filled with non-shrinking grout. This Contractor shall provide lead washers at all equipment anchor bolts.

F. Construct equipment supports above floor made of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

G. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment. See also Section 230548 “Vibration and Seismic Controls for Mechanical Piping”.

3.8 PREFABRICATED ROOFTOP EQUIPMENT SUPPORTS

A. Equipment Bases:

1. Equipment base shall be solid top combination equipment base with integral duct curb and stepped cant to match roof insulation. Base shall pitch to match roof pitch and provide level unit installation.
2. Base shall be constructed of reinforced 18-gauge galvanized steel with all welded components, full mitered corners, factory installed 1-1/2 inches thick rigid fiberglass insulation, wood nailer, and galvanized steel counter- flashing. Base shall be shipped as one piece.

B. All supports shall be installed in accordance with manufacturer's recommendations.

C. Prefab equipment Supports

1. Bolt support together using fasteners provided with support. Provide roofing protection pads.

3.9 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours at welded surfaces match adjacent contours.

3.10 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Cut off the bottom of threaded rods so they are no more than one rod diameter below the bottom nut.

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 section "Painting" of these specifications.

C. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR MECHANICAL SYSTEMS & EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division-23 sections.

1. All mechanical equipment, piping and ductwork as noted or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
3. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
4. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e., California Title 24, California Office of Statewide Health Planning and Development (OSHPD), Canadian Building Codes, or other requirements).
5. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
6. Seismic restraints shall be designed in accordance with seismic force levels as detailed in Section 1.7.

B. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Equipment isolation bases.
3. Flexible piping connections.
4. Seismic restraints for isolated equipment.
5. Seismic restraints for non-isolated equipment.
6. Certification of seismic restraint designs and installation supervision.
7. Certification of seismic attachment of housekeeping pads.
8. All mechanical and electrical systems (installed by Division 23, e.g., Temperature Controls). Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).
   a. Condensing Units
   b. Ductwork
   c. Fans (All types)
9. Fire protection systems are excluded from this section; see under separate fire protection sections.

C. Vibration control products furnished as integral part of factory-fabricated equipment shall comply with the requirements of this section.

D. For additional and supplemental requirements, refer to other Division 23 sections for equipment foundations; hangers; sealants; gaskets; requirements of electrical connections to equipment isolated on vibration control products; requirements of duct connections to air handling equipment isolated on vibration control products.

E. Definitions

1. Life Safety Systems:

a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems. See separate section(s) for fire protection requirements.
b. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection and/or emergency lighting systems.
c. All medical and life support systems.
d. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
e. All life safety equipment has an asterisk on the equipment schedule.

2. Positive Attachment:

a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

3. Transverse Bracing:

a. Restraint(s) applied to limit motion perpendicular to the center line of the pipe, duct or conduit.

4. Longitudinal Bracing:

a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration and seismic control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

1. Except as otherwise indicated, vibration and seismic control products shall be obtained from single manufacturer and shall be certified by the manufacturer.
2. Engage manufacturer to provide technical supervision of installation of support isolation and seismic units produced, and of associated inertia bases (if any).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration and seismic control product. Submit schedule showing size, type, deflection, and location for each product furnished.

1. Include data for each type and size of unit, showing specific restraints, isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment detailing compliance with the specification.
2. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics, ratio of horizontal to vertical stiffness and bases of spring-rated selection for range of loading weights.
3. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
4. Include performance certifications from manufacturers.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoring points and seismic restraints coordinated with equipment manufacturer's shop drawings.

1. Shop drawings showing structural design and details of inertia bases, steel beam bases and other custom-fabricated work not covered by manufacturer's submitted data.

a. Furnish templates, anchor bolts and sleeve for equipment bases, seismic restraints, foundations and other support systems for coordination of vibration isolation and seismic control units with other work.
b. Provide all details of suspension and support for ceiling hung equipment.
c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Submittals shall include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.
d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

2. Submit shop drawings indicating scope of vibration isolation work and locations of units and flexible connections. Include support isolation points for piping and ductwork including risers and inertia bases.

a. Include schedule of units, showing size or manufacturer's part number, and weight supported and resulting deflection of each unit.

C. Maintenance Data: Submit maintenance data for each type of vibration and seismic control product. Include this data, product data and shop drawings in maintenance manual; in accordance with requirements of Divisions 23.

D. Seismic Certification and Analysis:

1. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.

2. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45 degrees to the weakest mode.
3. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and-or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in Section 1.7 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.4 CODE AND STANDARDS REQUIREMENTS

A. Applicable Codes and Standards

1. International Building Code (IBC) currently adopted version.
2. All State and Local Codes.
3. ASHRAE HVAC Applications Handbook Sound and Vibration Control.
4. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems, latest edition.
5. SMACNA Seismic Restraint Manual Guidelines for Mechanical-OSHPD, latest edition.

1.5 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide vibration isolation and seismic restraints as scheduled or specified.
3. Provide calculations and materials if required for restraint of un-isolated equipment.
4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.6 RELATED WORK

A. Supplementary Support Steel

1. Contractor shall supply supplementary support steel for al equipment, piping, ductwork, etc. including roof mounted equipment, as required or specified.

B. Attachments

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.7 performance requirements

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III

a. Component Importance Factor: 1.25
b. Component Response Modification Factor: ASCE-7
c. Component Amplification Factor: per ASCE-7

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Refer to ASCE-7.
4. Design Spectral Response Acceleration at 1-Second Period: Refer to ASCE-7.
5. Refer to Structural plans and specifications to confirm information shown above and for additional information not presented above.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by:

1. Vibration and Seismic Control Products:

a. Mason Industries, Inc.
b. Kinetics Noise Control.
c. Vibration Mountings & Controls.

B. Alternate Manufacturer: All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. Mason Industries products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification and have been reviewed by the Engineer. Submittals and certification sheets shall be in accordance with Section 1.3.

C. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8 inch and/or horizontal permanent deformation greater than 1/4 inch.

2.2 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraints:

1. Two layers of ¾ inch thick neoprene pad consisting of 2 inches square waffle modules separated horizontally by a 16-gauge galvanized shim. Load distribution plates shall be used as required.

a. Basis of Design: Mason Type Super W.

2. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inches thick neoprene elements at the top and a steel spring with general characteristics as the spring hangers above seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and

the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degrees capability.

a. Basis of Design: Mason Type 30N.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PERFORMANCE OF ISOLATORS

A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units to achieve minimum static deflection and displacement requirements.

3.3 APPLICATIONS

A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Applications Handbook 2015, Table 47, Chapter 48 Noise and Vibration Control and Chapter 55 Seismic- and Wind-Resistant Design.

3.4 GENERAL

A. Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

B. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

C. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

D. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

E. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

F. Coordinate work with other trades to avoid rigid contact with the building.

G. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architect's/engineer's attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

H. Bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.

I. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.

J. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:

1. Flanges of structural beams.
2. Upper truss cords in bar joist construction.
3. Cast in place inserts or wedge type drill-in concrete anchors.

K. Seismic cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, piping or conduit.

L. Seismic cable restraint assemblies are installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems only.

M. At locations where seismic cable restraints or seismic solid braces are located, the support rods must be braced when necessary to accept compressive loads with Specification 14 braces.

N. At all locations where seismic cable restraints or seismic solid braces restraints are attached to pipe clevis's, the clevis cross bolt must be reinforces with pipe clevis cross bolt braces.

O. Drill-in concrete anchors for ceiling and wall installation shall be stud wedge anchors, and female wedge anchors for floor mounted equipment.

P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.

Q. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces.

R. Hand built elastomeric expansion joints maybe used when pipe sizes exceed 24 inches or specified movements exceed capability of flexible spherical expansion joints.

S. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide split wall seals.

T. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weightusing horizontal thrust restraints.

U. Locate isolation hangers as near to the overhead support structure as possible.

V. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

W. Install inertia base frames on isolator units so that minimum of 1inch clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.

X. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10 percent of equipment weight.

Y. Weld riser isolator units in place as required to prevent displacement from loading and operations.

Z. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.5 VIBRATION ISOLATION OF PIPING

A. Seismic Restraint of Piping

1. Seismically restrain all piping listed as a, b or c below. Use seismic cable restraints if isolated. Seismic cable restraints or seismic solid braces may be used on un-isolated piping.

    a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping that is 1 inch I.D. or larger.
    b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1-1/4 inch I.D. and larger.
    c. All other piping 2-1/2 inch diameter and larger.

2. Transverse piping restraints shall be at 40 feet maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Longitudinal restraints shall be 80 feet maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induces by expansion or contraction.
5. For fuel oil and all gas piping transverse restraints shall be at 20 feet maximum and longitudinal restraints at 40 feet maximum spacing.
6. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24inches of the elbow or tee or combined stresses are within allowable limits at longer distances.
7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
8. Branch lines may not be used to restrain main lines.
9. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly shall be braced in accordance with seismic product manufacturer's recommendations and SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

B. Vibration Isolation of Ductwork

1. All discharge runs for a distance of 50 feet from the connected equipment shall be isolated from the building structure by means of Specification 10 hangers or Specification 5 floor isolators. Spring deflection shall be a minimum of 0.75 inches.

C. Seismic Restraint of Ductwork

1. Seismically restrain all duct work with seismic cable restraints or seismic solid braces as listed below:

    a. Restrain rectangular ducts with cross sectional area of 6 sq. feet or larger.
    b. Restrain round ducts with diameters of 28 inches or larger.
    c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.

2. Transverse restraints shall occur at 30 foot intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
3. Longitudinal restraints shall occur at 60 foot intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4 feet of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
5. A group of ducts may be combined in a larger frame so that the combined weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non-bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.

3.6 SEISMIC RESTRAINT EXCLUSIONS

A. Piping

1. All piping less than 2-1/2 Inches in diameter except those listed below.
2. All gas piping, fuel oil piping and medical gas piping less than 1 inch I.D.
3. All piping in boiler and mechanical equipment rooms less than 1-1/4-inch I.D.
4. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than 12 inches in length from the structure to the structural connection of the clevis or trapeze.
5. All PVC and fiberglass suspended waste or vent pipe 6 inches in diameter and smaller.

B. Duct Work

1. Rectangular, square or oval ducts less than 6 sq. feet in cross sectional area.
2. Round duct less than 28 inches in diameter.
3. Duct supported by hanger rods where the point of attachment is less than 12 inches in length from the structure to the structural connection of the duct work.

C. Electrical

1. All conduit less than 2-1/2 inches in diameter suspended by individual hanger rods.
2. All clevis or trapeze supported conduits suspended by hanger rods where the point of attachment is less than 12 inches in length from the structure to the structural connection of the clevis or trapeze.

D. Suspended Equipment

1. VAV boxes and fan powered equipment weighing less than 50 lbs. and rigidly connected to the supply side of the duct system and supported with a minimum of 4 hanger rods.

3.7 EXAMINATION OF RELATED WORK

A. Installer of vibration isolation work shall observe installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish written report to Engineer listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:

1. Equipment installations (performed as work of other sections) on vibration isolators.
2. Piping connections including flexible connections.
3. Ductwork connections including provisions for flexible connections.
4. Passage of piping and ductwork which is to be isolated through walls and floors.

B. Do not start-up equipment until inadequacies have been corrected.

3.8 ADJUSTING AND CLEANING

A. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short- circuit unit isolation.

3.9 DEFLECTION MEASUREMENTS

A. Upon completion of vibration isolation work, prepare report showing measured equipment deflections theoretical floor deflection and isolation efficiency for each major item of equipment.

PART 4 - SCHEDULES

4.1 EQUIPMENT VIBRATION ISOLATION TABLE:

A. The following Base and Isolator Types are for these tables only. Refer to Part 2 and Part 3 for additional information.

//EDIT NOTE: REVIEW THE FOLLOWING TABLES AND EDIT TO REMOVE LINE ITEMS THAT DO NOT APPLY TO YOUR PROJECT. BASED ON ASHRAE 2015, CHAPTER 48, PG. 45, TABLE 47. COORDINATE WITH ACOUSTICAL CONSULTANT IF ONE IS ON THE PROJECT.

Base Type Legend:	**Isolator Type Legend:**
A = No base, isolators attached directly to equipment	1 = Pad, rubber or glass fiber
B = Structural steel rails or base	2 = Rubber floor isolator or hanger
C = Concrete inertia base	3 = Spring floor isolator or hanger
D = Curb-mounted base	4 = Restrained spring isolator
N/A = Not Applicable	5 = Thrust restraint

Equipment Type	**Slab On Grade**			**Up To 20-FT Floor Span**		
	Base Type	**Isol Type**	**Min. Defl. (Inches)**	**Base Type**	**Isol Type**	**Min. Defl. (Inches)**
Condensing Units						

Equipment Type	Slab On Grade			Up To 20-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
All Types and Sizes	A	1	0.25	A	4	0.75
Ducted Rotating Equipment						
Small Fans, Fan Powered Boxes, 600 CFM and smaller	A	3	0.50	A	3	0.50

END OF SECTION 230548

SECTION 230553 – IDENTIFICATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Existing Building Standards: Comply with the existing building identification system for lettering size, length of color field, colors and identification method unless otherwise indicated.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), size of valve, and variations for identification (if any). Only tag valves which are intended for emergency shut-off and similar special uses, such as valve to isolate individual system risers, individual floor branches or building system shut off valves. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

B. Mechanical Identification: Equipment signs, pipe labels, duct labels, valve tags, and stencils

1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Brimar Industries, Inc.
4. Carlton
5. Industrial Safety Supply Co., Inc.
6. Kolbi
7. Seton Name Plate Corp.
8. PVC Specialties
9. Marking Services, Inc. (MSI)

2.2 MECHANICAL IDENTIFICATION MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1-inch-thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. or greater. Cut length to extend 2inches beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2inch.

D. Large Pipes: For external diameters of 6inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Steel spring or non-metallic fasteners.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2inches wide; full circle at both ends of pipe marker, tape lapped 3inches.
3. Strapped-to-pipe (or insulation) application of semi- rigid type, with manufacturer's standard stainless-steel bands.

E. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, duct markers.

B. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.

C. Nomenclature: Include the following:

1. Direction of air flow.
2. Duct service (supply, return, exhaust, etc.)

2.5 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2inches wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6inches, 2-1/2inches wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKERS

A. General: Manufacturer's standard permanent, bright- colored, continuous-printed plastic detectable tape, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

B. Tape to be multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4inch high letters and sequenced valve numbers 1/2inch high, and with 5/32inch hole for fastener.

1. Provide 1-1/2inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), and solid brass S- hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer's standard 1/16-inch-thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

2.8 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, scheduled and approved by the Owner/Engineer. Provide numbers, lettering and wording as indicated and approved by the Owner/Engineer for proper identification and operation/ maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as designated on the drawings or schedule as well as service.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Install markers or stencils to identify air supply, return, exhaust, intake, outdoor, and relief ductwork and duct access doors with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color). For Existing building identification, match the method which exists in the building.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment), other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers and identification for all piping installed on project. Use nomenclature and abbreviations as listed on drawings, in the schedules and legends. Submit list with product submittal for review.

B. General: Install pipe markers of the following type on each system indicated to receive identification and include arrows to show normal direction of flow. Existing building identification shall match the existing method in the building.

C. Plastic pipe markers, color per ASME A13.1, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

E. Near each valve and control device.

F. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

G. Near locations where pipes pass through walls or floors/ceilings or enter non-accessible enclosures.

H. At access doors, manholes and similar access points which permit view of concealed piping.

I. Near major equipment items and other points of origination and termination.

J. Spaced intermediately at maximum spacing of 25 feet along each piping run, except reduce spacing to 15' in congested areas of piping and equipment.

K. On piping above removable acoustical ceilings.

L. Install identification and label the following piping systems:

1. Refrigerant piping
2.
3. “All” piping installed in project. Use name as listed in legends and schedules.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.

1. Building services main shut-off valves.
2. Each individual system main shut-off valves.
3. Each individual system riser shut-off valves.
4. Each individual system floor shut-off valves.
5. Each individual system major branch shut-off valves.

B. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.

C. Where more than one major mechanical equipment room is shown for project, install mounted valve schedule in each major mechanical equipment room, and repeat only main valves which are to be operated in conjunction with operations of more than single mechanical equipment room.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install minimum 2-inch x 4 inch engraved plastic laminate equipment marker on each individual items of mechanical equipment. Provide marker for the following general categories of equipment.

1. Main building systems control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Room thermostats, except gun tag labels are acceptable for room thermostats.
3. Fans and blowers.

B. Lettering Size: Minimum 1/4-inch-high lettering for name of unit.

C. Text of Signs: In addition to the identified unit, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

D. Hand-Lettered Equipment Identification Option: If proposed to and accepted by the Owner in writing, the Contractor shall have the option of providing hand-lettered equipment identification above accessible ceilings for the following equipment:

1. Air Terminal Units: Identification shall be provided on left and right sides and on the bottom of the unit. Letters shall be clear and concise, minimum 1” high, in color contrasting with that of the unit.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers testing and balancing of environmental systems described herein and specified under Division 23. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting firm.

1. Test, adjust and balance the following mechanical systems and the mechanical equipment associated with these systems:

a. General Systems and Equipment Procedures.
b. Air Side Systems and Equipment

1) Supply/Return Air Systems
2) General Exhaust/Supply Fans
3)
4) General Exhaust Systems

c. Refrigeration Systems and Equipment

1) General
2) Condensing units

d. Electrical Components

1) Electric resistance heating

1.2 QUALIFICATIONS OF CONTRACTOR

A. The Mechanical Contractor shall procure the services of an independent testing and balancing agency specializing in the testing, adjusting and balancing of environmental systems to perform the above-mentioned work. An independent contractor is defined as an organization that is not engaged in engineering design or is not a division of a mechanical contractor entity, which installs mechanical systems.

B. The actual fieldwork shall be performed by qualified technicians who are currently certified by the Testing, Adjusting and Balancing Bureau (TABB), the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC) certification agencies.

C. The Testing & Balancing Contractor shall have a minimum of three years' experience in testing and balancing mechanical systems.

D. The Test & Balance Contractor shall have previous experience in testing and balancing variable air volume laboratory fume hood systems in the last two years. Qualification submission must include a detailed resume describing past project experience in laboratory variable air volume systems, a list of projects, including peoples' names, phone numbers and addresses of references.

1.3 APPROVAL OF CONTRACTOR

A. The following firms are preferred contractors to complete the work. Any Testing and Balancing firm desiring to offer their services for this work and who are not listed below, shall submit their qualifications to the Architect, not less than seven (7) working days before the bid date. Approval or disapproval will be given on each request and this action will be given in writing prior to bidding the work.

1. Blue Sky
2. NWESI
3. Evolve
4. Accurate Air
5. BST

B. Firms who are not listed, or who have not received prior approval shall not be approved to complete work on this project.

1.4 CODES AND STANDARDS

A. ASHRAE: ASHRAE Handbook, Applications Volume, Testing, Adjusting, and Balancing Chapter.

B. NEBB: “Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.”

C. SMACNA: “HVAC Systems-Testing, Adjusting & Balancing.”

1.5 PRELIMINARY SUBMITTALS

A. Within ten (10) days of award of the contract the Mechanical Contractor shall submit the name of the Test and Balance Contractor who will be performing the work. The submittal shall include a complete list of all technicians who will be performing the field work and include a photocopy of their current certification by either NEBB, AABC, or TABB certification agencies. Only those technicians included in the submittal shall perform the work. Any personnel or staff used to perform the work without prior approval of the Engineer, who are not included in the submittal, shall be grounds for rejecting the test and balance report and the project in whole.

B. Meet all requirements of Section 230500 “Common Work Results for Mechanical” as applicable.

C. Submit a list of all instrumentation to be used on an individual project and include calibration dates. Submit calibration curves. If more than one instrument of a similar type is used, a comparison of individual readings should be made. The variation between instrument readings should not exceed plus or minus 5%.

1.6 FINAL REPORTS

A. Refer to Division 1 for supplemental requirements.

B. The Testing and Balancing Contractor shall submit the final testing and balancing report at least fifteen (15) calendar days prior to substantial completion, unless noted otherwise in Division 1. Report contents shall be per Part 3 of this Section.

C. Meet all requirements of Section 230500 “Common Work Results for Mechanical” as applicable.

D. If more than two reports are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

1.7 SEQUENCING AND SCHEDULING

A. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.

B. Prepare a project schedule. Schedule shall indicate critical path of the balancing process and shall incorporate both requirements of other contractors necessary to meet test and balance commitments and process flow of test and balance work. Coordinate with general and mechanical contractors and insert critical steps into project master schedule.

PART 2 - PRODUCTS

2.1 BELTS, SHEAVES, IMPELLERS

A. Refer to specific equipment sections and Section 230500 “Common Work Results for Mechanical” for additional requirements.

B. The Testing & Balancing Contractor shall coordinate with the Mechanical Contractor to supply correctly sized drive belts and sheaves. Impellers shall be trimmed or replaced by the mechanical contractor and shall be correctly re-sized and coordinated by the Test and Balancing Contractor per the hydronic systems and equipment portion of this section.

PART 3 - EXECUTION

3.1 preliminary procedures – remodel work

A. In remodel area, a complete preliminary test and balance report shall be accomplished prior to any work. Any obvious deficiencies shall be identified at that time. A complete report of all readings, recommendations, etc. shall be submitted to the Engineer.

3.2 GENERAL SYSTEM AND EQUIPMENT PROCEDURES

A. Balance all air and water flows at terminals within +10% to -5% of design flow quantities. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.

B. Pressure relationships indicated on drawings shall take priority over air quantities.

C. Mark equipment settings with paint, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.

D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommend by the original installer.

E. Measure, adjust and report equipment running motor amps and power factor, KW, rated motor amperage, listed motor power factor, voltage, and all nameplate data. Perform these measurements for all equipment operational modes.

F. Check and adjust equipment belt tensioning.

G. Check keyway and setscrew tightness. Report any loose screws and notify Mechanical Contractor prior to equipment balancing.

H. Record and include in report all equipment nameplate data.

I. Verify that all equipment safety and operating controls are in place, tested, adjusted and set prior to balancing.

J. Verify that manufacturer start-up has occurred per specification prior to balancing.

3.3 AIR SIDE SYSTEMS AND EQUIPMENT PROCEDURES

A. In addition to the procedures identified under each specific heading below, provide general data required by 3.3 above.

B. Filters shall be restricted to increase pressure drop to 50% of span between initial pressure drop and final recommended pressure drop for setting final airflows for fans. Check fan motor amps with clean filters and simulated loaded filters, and report for each piece of equipment. Equipment shall be supplied with clean filters upon completion of balance. Balance and report air quantities.

C. Supply/Return Air Systems:

1. Balance and report supply and return diffuser/grille quantities. Air diffusion patterns shall be set as noted on drawings and to minimize objectionable drafts and noise.
2. Provide full pitot traverses in duct mains downstream of supply fans, upstream of return fans, and in each zone duct downstream of a multizone unit. For VAV systems perform these at the system diversity condition (if any). Balance and report air quantities.
3. Provide full pitot traverses at each air terminal or duct coil. For VAV systems, perform these at zone maximum air condition. Balance and report air quantities.
4. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.

D. General Exhaust Fans:

1. Adjust CFM to system requirements. For belt drive include sheave and belt exchange to deliver airflow within limits of installed motor horsepower and mechanical stress limits of the fan. Determine the limiting fan tip speed before increasing RPM. Final fan speed setting shall allow for filter loading (as applicable) and shall establish proper duct pressures for operation of zone CFM regulators. For direct drive with speed taps: Set fan speed on tap which most closely approaches design CFM by adjusting the speed control After adjustment, check fans ability to re-start after powering down. Increase setting if required for proper starting.
2. Measure and report static pressures upstream and downstream of all fans.
3. Measure and report fan RPM.
4. Report design fan inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice.

E. General Exhaust Systems:

1. Balance and report exhaust grille quantities. Report objectionable noise.
2. Provide full pitot traverses at each individual exhaust riser and at each exhaust fan. Balance and report.
3. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.

3.4 REFRIGERATION SYSTEMS AND EQUIPMENT

A. General.

B. Evaporator Coils:

1. Measure and report temperature upstream and downstream of evaporator coils at all stages of cooling at all design air quantities. Calculate and report coil face velocities.

3.5 ELECTRICAL COMPONENTS ASSOCIATED WITH MECHANICAL SYSTEMS

A. Electric Resistance Heating Systems and Equipment:

1. Measure full load amperage at full heating and design CFM and report.
2. Electric heaters in an airstream shall have entering and leaving air temperature measured and reported for all stages of heating.

3.6 CONTROL SYSTEMS AND EQUIPMENT

A. General:

1. Operate all temperature control systems with the temperature control contractor's representative for proper sequence of operation. Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air system flow measurement stations including VAV terminals shall be calibrated against a Pitot tube traverse or air diffuser capture hood. Balancing Contractor shall assure accuracy of all flow measurement devices or shall report their failure to be accurate.
2. Work with the Controls Contractor to set minimum outside air damper positions.
3. Work with the Controls Contractor to optimize VAV duct static pressure, VFD pump hydronic system pressure differential and building pressure.

3.7 REPORT OF WORK

A. The Testing and Balancing Contractor shall submit electronic copies of the final testing and balancing report at least fifteen (15) calendar days prior to the Mechanical Contractor's request for final inspection.

B. A complete reduced set of mechanical contract drawings (showing each system) shall be included in the report with all equipment, flow measuring devices, terminals (outlets, inlets, coils, fan coil units, schedules, etc.) clearly marked and all equipment designated. The test and balance contractor can obtain drawing files from Cator, Ruma, & Associates for development of these drawings.

C. Data shall be reported per Part 3 of this Section on standard NEBB, TABB, or AABC forms. Generate custom forms that contain the information in this Section when a standard form does not exist for a

piece of equipment. All forms shall be fully filled out for this report. When additional information is required by this Section, it shall be provided.

D. The report shall include a list of all equipment used in the testing and balancing work.

E. Report systems for excessive sound and vibration per the sound and vibration inspection and testing portions of this specification.

F. Substantial completion of this project will not take place until a satisfactory report is received. The Testing & Balancing Contractor shall respond to and correct all deficiencies within seven (7) days of receiving the Engineer's written review of the balancing report. Failure to comply will result in holding retainage of the final payment until all items have been corrected to the satisfaction of the Engineer.

G. The report shall be signed by the supervising registered professional engineer and affixed with their registration stamp, signed and dated in accordance with state law.

3.8 GUARANTEE OF WORK

A. The Testing & Balancing Contractor shall guarantee the accuracy of the tests and balance for a period of 90 days from date of final acceptance of the test and balance report. During this period, the Testing & Balancing Contractor shall make personnel available at no cost to the Owner to correct deficiencies that may become apparent in the system balance.

END OF SECTION 230593

SECTION 230700 – INSULATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc. label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

D. Definitions

1. ASJ: All Surface Jacket.
2. FSK: Foil Scrim Kraft.
3. MRT: Mean Temperature Rating.
4. NRTL: Nationally Recognized Testing Laboratory
5. PCF: Pounds per Cubic Foot.
6. PSF: Pounds per Square Foot.
7. SSL: Self Sealing Lap

E. Codes and Standards:

1. International Energy Conservation Code currently adopted version.
2. ASHRAE 90.1, latest edition.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Submit detail product information and installation information for all jacketing systems specified in this section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

1. Mechanical Insulation:

a. Johns Manville Corp.
b. Owens-Corning Fiberglas Corp.
c. Knauf Fiber Glass
d. Manson
e. CertainTeed
f. Einsulation
g. Armacell
h. Pittsburgh Corning Corp.
i. Aeroflex.
j. PABCO, Inc.
k. Rubatex Corp.
l. Thermal Structures

2. Jacketing & Covering Products:

a. Childers
b. Ceel-Co
c. Zeston
d. Alpha Associates, Inc.
e. Venture Tape
f. Polyguard

2.2 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class I unless otherwise indicated. ASJ-SSL Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint. “K” factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.

B. Cellular Glass Piping Insulation: ASTM C 552, Type II, Class 2. Permeability of 0.00 perm. Preformed pipe insulation with factory-applied all-service jacket with self-sealing lap. “K” factor shall be maximum 0.28 at 50°F MRT, 0.29 at 75°F MRT, 0.31 at 100°F MRT, 0.38 at 200°F MRT and 0.45 at 300°F MRT.

C. Calcium Silicate Piping Insulation: ASTM C533, Type I. "K" factor shall be maximum 0.538 at 500°F mean temperature, ASTM C165 compression strength >100 psi for 5 percent compression, transverse strength 200 psi for 5 percent compression, flexural strength 60 psi.

D. Flexible Elastomeric, Closed Cell Piping Insulation: ASTM C 534, Type I. Water vapor permeability of 0.10 perm inches or less. Insulation shall be pre-installed on piping, or un-slit to be slipped over piping as a single piece. “K” factor shall be maximum 0.245 at 50°F MRT, 0.25 at 75°F MRT and 0.26 at 90°F MRT.

E. Flexible Thermal Ceramic Insulation: "K" factor shall be a maximum of 1.5 at 1500°F mean temperature, 2000°F temperature limit. Provide presized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, unless otherwise indicated.

F. Jackets for Piping Insulation:

1. ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
2. Fitting Covers: UV resistant PVC, pre-molded fitting covers, flame spread 25, smoke developed 50. PVC tape for cold systems, serrated tacks or PVC tape for hot systems.
3. Self-Adhesive Laminate Jacketing: Heavy duty multilayered laminate coated with an acrylic pressure sensitive adhesive. Embossed aluminum surface. Zero permeability vapor barrier for insulation cladding and jacketing applications. Superior resistance to weathering, mold, UV, and extreme environmental conditions.

    a. Product thickness (flat): 17.5 mils
    b. Product Thickness (embossed): 24.0 mils
    c. Peel Adhesion: 100 oz/in
    d. Tensile Strength: 187 lb/in
    e. Puncture: 68 lbs
    f. Water Vapor Transmission Rate (ASTM E96): 0.0
    g. Service Temperature: -94 to 248 °F
    h. VentureTape 1579GCW-E (VentureClad Plus) or equivalent.

4. Aluminum Jacketing: Manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16" corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be 0.016" thick minimum. Provide matching factory fabricated covers for 90-degree and 45-degree elbows, tee fittings, flange fittings valve bodies, blind ends, reducers and other fittings necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.
5.
6. PVC Jacketing: UV resistant PVC, 30 mil thick, flame spread 25, smoke developed 50, factory cut and curled to fit outside diameter of insulated pipe. Solvent weld adhesive for sealing joints and seams.
7.
8. Rubber/Tedlar Jacketing: ASTM-D-1424-63, ASTM-D-774, and ASTM-E-84, manufactured from a combination of heavy fiberglass fabric coated with Hypalon Rubber, fully cured and laminated to a Tedlar facing. Jacketing will also be required to be vapor barrier and shall be laminated to a corrosion resistant aluminized Mylar. Jacketing shall be .010" thick minimum, UL Class I rated, acid and alkali resistant, and be both washable and paintable. Provide factory fabricated aluminum fitting covers with mil-polyethylene vapor barrier for all elbows, tees, flanges, valves, and other fittings. Alpha Associates Style TGH-1000 or equal.
9.
10. Cloth Jacketing Material: Not less than 8 oz. per square yard with adhesives, cement and sealer as recommended by insulation manufacturer for the intended application. PVC premolded fitting covers shall not be provided.

G. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

H. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated and additional finishes as specified.

2.3 DUCTWORK INSULATION MATERIALS

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class I, 450°F temperature limit, density of 3 PCF. "K" value shall be maximum 0.23 at 75°F mean temperature, vapor transmission rating shall not exceed 0.02 perms, FSK facing.

B. Round Surface Semi-Rigid Fiberglass Blanket Insulation: ATSM C 612, Class I, 450°F temperature limit, 2.5 PCF density “K” value of 0.25 max at 75°F mean temp, FSK facing. Orientation of fibers shall be perpendicular to facing to facilitate application on round surfaces.

C. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, 3/4 lbs per cu. ft. density. "K" value shall be maximum 0.30 at 75°F mean temperature, 250°F temperature limit, vapor transmission rating shall not exceed 0.02 perms, FSK facing.

D. Flexible Elastomeric Closed Cell Insulation: ASTM C534, Type II, "K" value shall be a maximum 0.28 at 75°F mean temp, 220°F Temperature limit, water vapor permeability rating of 0.10 perm inches or less.

E. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient. Type I may be used for all at Contractors option.

1. Aluminum Jacketing: The jacketing shall be manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16-inch corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be 0.016 inches thick minimum. Where available, provide matching factory fabricated covers for 90-degree and 45-degree elbows, tee fittings, branch fittings, reducers and other fittings necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.
2. Rubber/Tedlar Jacketing: ASTM-D-1424-63, ASTM-D-774, and ASTM-E-84, manufactured from a combination of heavy fiberglass fabric coated with Hypalon Rubber, fully cured and laminated to a Tedlar facing. Jacketing will also be required to be vapor barrier and shall be laminated to a corrosion resistant aluminized Mylar. Jacketing shall be .010" thick minimum, UL Class I rated, acid and alkali resistant, and be both washable and paintable. Provide factory fabricated aluminum fitting covers with mil-polyethylene vapor barrier for all elbows, tees, and other fittings. Alpha Associates Style TGH-1000 or equal.
3. Flexible closed cell elastomeric insulation shall be coated with two coats Armaflex WB Finish or other UV and weather coating. Barrier product recommended by the insulation manufacturer.

F. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

G. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 minimum insulation requirements

A. All mechanical systems shall be insulated in accordance with the locally adopted energy codes or the requirements of this specification section, whichever is more stringent.

3.2 general:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.

C. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

3.3 HVAC PIPING SYSTEM INSULATION

A. Sub-Freezing Piping (39°F and Lower):

1. Application Requirements: Insulate the following piping systems:

a. Refrigerant suction lines between evaporators and compressors.

2. Insulate each piping system specified above with the following types and thicknesses of insulation:

a. Above Ground, Inside Building, Elastomeric:

1) 1/2-inch-thick insulation on pipe sizes smaller than 1 inch.
2) 1-inch-thick insulation on pipe sizes 1 inch to 6 inch.
3) 1.5-inch-thick insulation on pipe sizes 8 inch and larger.

b. Above Ground, Exterior, Cellular Glass:

1) 3/4-inch-thick insulation on pipe sizes smaller than 1 inch.
2) 1.5-inch-thick insulation on pipe sizes 1 inch to 8 inch.
3) 2-inch-thick insulation on pipe sizes larger than 8 inch.

3.4 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted: Do not insulate lined ductwork unless additional wrap is required to meet Energy Code.

B. Application Requirements: Insulate the following ductwork and equipment:

1. Outdoor air intake ductwork and plenums between air entrance and HVAC unit inlet.
2. Mixed air ductwork and plenums between air entrance and HVAC unit inlet.
3. HVAC supply ductwork between HVAC unit discharge, and room terminal outlet unless ductwork is specified to be lined.
4. HVAC return ductwork in unconditioned spaces or exterior; except omit insulation when ductwork is specified to be lined.
5. HVAC plenums and unit housings not pre-insulated at factory or lined.
6. Rigid oval or round supply air ductwork.
7. Induced draft fan scrolls.

C. Insulate outdoor, supply, return, makeup and ERV exhaust air ducts with R-6 blaknet insulation with FSK Jacket. If duct is outside envelope use R-12.

3.5 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on cold pipe insulation and protect to prevent puncture or other damage.

1. Do not use staples or tacks on vapor barrier jackets.
2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
3. Seal fitting covers with PVC tape.
4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identify item covered.

F. Neatly bevel and seal insulation at all exposed edges.

G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

I. See equipment insulation for removable insulation on accessible piping components.

J. See Section 230529 for insulation inserts and shields. Butt pipe insulation against pipe hanger insulation inserts. For all piping apply wet coat of vapor barrier lap cement on butt joints and seal all joints and seams with 3-inch-wide vapor barrier tape or band.

K. Flexible Elastomeric Piping Insulation:

1. Install unslit, by slipping over piping prior to joining, or install pre-insulated soft copper tubing.
2. Seal butt ends with adhesive.

L. Cellular Glass Insulation:

1. Apply in a single layer. Secure to pipe with ½ inch wide aluminum bands.
2. For indoor applications, apply all-purpose Kraft paper/aluminum foil/vinyl coating jacket. Seal all lap and butt joints with self-seal vapor barrier tape.
3. For outdoor applications, apply aluminum rubber/Tedlar jacketing as described below.

M. Calcium Silicate Insulation:

1. Apply in a single layer. Secure to pipe with 1/2-inch-wide aluminum bands.
2. For indoor applications, provide canvas jacketing. Adhere joints of jacketing and provide a finish coat of sealant as recommended by the manufacturer.

N. Piping Exposed to Weather: Protect outdoor insulation from weather by installing aluminum or self-adhesive laminate jacketing.

1. Aluminum jacketing shall be secured by 1/2-inch-wide stainless-steel bands located on 24-inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose prefabricated sealing and fastening systems, submit samples and product data for approval.
2. On flexible elastomeric pipe insulation apply two (2) coats of manufacturer's approved U.V. resistant finish

3.6 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage.

1. Avoid the use of staples on vapor barrier jackets.
2. Seal vapor barrier penetrations with vapor barrier tape recommended by the manufacturer.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation has been installed. Sound attenuators do not qualify for this omission.

G. Flexible Fiberglass Insulation: Cut back insulation to provide a 2-inch facing overlap at all seams. Seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with pressure-sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18inches on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above. Install with a maximum of 25% compression to maintain the manufacturer published installed R-value.

H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on all external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

I. Adhere flexible elastomeric sheets to clean oil-free metal surface by compression fit method and full coverage of adhesive. Seal butt joints with same adhesive. For exterior ductwork, notch insulation at reinforcements and joint flanges to provide a smooth surface, unless the reinforcements or joints

would penetrate the insulation. Provide a minimum ½ inch cap over any penetrating item. Stagger all joints and seams on multi-layer insulation.

J. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing aluminum or self-adhesive laminate jacketing

1. Fabricate rectangular ductwork to have a minimum 1/2” per foot slope on the top surface, and/or slope insulation to prevent ponding.
2. Aluminum jacketing shall be secured by 1/2-inch-wide stainless-steel bands located on 24 inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose prefabricated sealing and fastening systems, submit samples and product data for approval.
3. Install self-adhesive laminate jacketing in accordance with the manufacturer’s instructions. Seal all joints with minimum 4” wide tape having the same properties as the main jacketing system.

3.7 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.

3.8 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230700

SECTION 230933 - ELECTRIC AND ELECTRONIC CONTROL MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electric control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.

1. Control sequences are specified in Division 23, Section 230993, "Sequence of Operation for Mechanical Systems".

B. Refer to other Division 23 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems.

C. Provide electrical work as required, complying with requirements of Division-26 sections. Work in addition to that shown in Division 26 drawings includes, but is not limited to, the following:

1. Interlock and control wiring between field-installed controls, indicating devices, and unit control panels.
2. The Contractor shall be responsible for all additional electrical and other costs involved to accommodate the temperature control system panel, motors and electrical devices requiring power which differs from the power requirements shown on the electrical drawings.
3. Refer to Division 26 on mechanical/electrical coordination.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms specializing and experienced in electric control system installations for not less than 5 years.

C. Bids by Wholesalers, Contractors, Franchised Dealers, or any firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable.

D. Codes and Standards:

1. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by UL and comply with NEMA standards.
2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.
3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

B. Shop Drawings: Submit shop drawings for each electric control system, containing, but not limited to, the following information:

1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.
2. Label each control device with setting or adjustable range of control.
3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
4. Provide details of faces of control panels, including controls, instruments, and labeling.
5. Include verbal description of sequence of operation.

C. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

D. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 23.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Electric Control Systems:

a. American Auto-Matrix
b. Honeywell, Inc.
c. Johnson Controls, Inc.
d. Siebe Environmental Controls
e. Staefa Control Systems, Inc.
f. Landis and Gyr Powers, Inc.

2.2 MATERIALS AND EQUIPMENT

A. General: Provide electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as

recommended by manufacturer. Provide electric control systems with the following functional and construction features as indicated.

B. Room Thermostats: Provide room thermostats with locking covers, and with concealed or readily-accessible adjustment devices and dead band, as indicated.

1. Provide thermostats with red-reading glass or spiral bi- metallic thermometers.
2. Where indicated, provide heavy-duty "asylum type", clear plastic, or wire tamper-proof guards.
3. Line-Voltage On-Off Thermostats: Provide thermostats of bi-metal actuated open contact, or bellows actuated enclosed snap-switch type, or equivalent solid-state type; UL-listed at electrical rating comparable with application. Provide bimetal thermostats which employ heat anticipation. Equip thermostats which control electric heating loads directly, with Off position on dial wired to break ungrounded conductors.
4. Combination Thermostat and Fan Switches: Comply with requirements for line-voltage thermostats. In addition, include as integral part of each thermostat, 2-, 3-, or 4-position push-button or lever operated manual switch for control of fan in each unit with type of control as indicated.

    a. Label switches "fan on-off" "fan high-low-off", "fan high-med-low-off". Provide factory-fabricated unit, capable of being mounted on 2-gang switch box or mud ring.

5. Low-Voltage On-Off Thermostats: Comply with general requirement indicated for line-voltage thermostats. Provide thermostats of bimetal operated mercury-switch type, with either adjustable or fixed universal anticipation heater.
6. Low-Voltage Modulating Thermostats: Provide potentiometer type, operated by vapor-filled bellows.

C. Fan Speed Controllers: Provide solid-state fan speed controllers, to maintain room temperature by varying fan speed on fan units, in response to room temperature changes. Provide proportioning control of motor speed, from maximum down to minimum of 55% (field adjustable). Equip controller to provide on-off action below demand for minimum fan speed, to prevent low-speed operation and ensure normal motor life. Design controller to apply full- voltage for brief period each time motor is started, to bring motor up to minimum speed rapidly. Equip controller with filter circuit to eliminate objectionable radio interference.

D. Electric Heat Current Controllers: Accomplish switching of load current with semiconductor devices located in load circuit of operation controller, and not by mechanical or mercury relays. Provide controllers which operate on zero- voltage switching principle, to minimize radio frequency interference; do not substitute devices incorporating phase control firing. Arrange power controllers, for loads of 10-kw or larger, for 3-phase operation. Incorporate solid- state switch for loads of 48-amps per phase or larger, in each ungrounded line of load circuit.

1. Refer to heating equipment specifications for integral high temperature limit controllers.

2.3 ELECTRICAL MATERIALS

A. Conduit: Types as indicated in Division 26 sized per Division 26 except for low voltage twisted pair or single jacketed cable (1/2" minimum).

B. Fittings per Division 26. Bushings or nylon insulated throats are not required for jacketed cables.

C. All J-boxes shall be identified and labeled per Division 26.

D. All conductors and cables shall be labeled per Division 26.

E. Conduit and box supports shall be per Division 26.

F. Junction boxes shall be of types and sizes as indicated in Division 26.

G. All wiring shall be installed in conduit.

H. Conduits shall not exceed 40% maximum fill for single conductor and jacketed cables.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats 60 inches (1524 mm) above floor.

3.2 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-26 sections of these specifications. Mount controllers at convenient locations and heights.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.

C. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

E. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.

F. Unit-Mounted Equipment: Where control devices are indicated to be unit-mounted, ship electric relays, electric switches, valves, dampers, and damper motors to unit manufacturer for mounting and wiring at factory.

3.3 ADJUSTING AND CLEANING

A. Start-Up: Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.

1. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.4 POST INSTALLATION INSPECTION AND REPORT

A. Upon completion of the temperature control installation, the complete system shall be checked by an engineer of the control contractor and certified by him in a report to the Architect/Engineer that the system is performing as specified.

3.5 CLOSEOUT PROCEDURES

A. Owner's Instructions: Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of electric control systems.

1. Schedule instruction with Owner. Provide at least 7-day notice to Contractor and Engineer of training date.

END OF SECTION 230933

SECTION 230993 - SEQUENCES OF OPERATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.

B. Operating equipment, devices, and system components required for control systems are specified in other Division 23 Controls' sections of these specifications.

C. The following sequences represent the design intent for the operation of the equipment contained within this section. It is the contractor’s responsibility to coordinate the method and extent of control with various vendors, manufacturers and specialty contractors to accomplish this intent.

D. These sequences are intended to be performance based. Implementations that provide the same functional result using different underlying detailed logic will be acceptable if the approach is clearly illustrated in the contractor’s submittal and coordinated prior to implementation.

E. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.

1. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a Neutral value. Do not allow loops to count (up or down) when equipment is not running.
2. A control loop in Neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.

F. When there are multiple outdoor air temperature sensors, the system shall use the valid sensor that most accurately represents the outdoor air conditions at the equipment being controlled.

G. Outdoor air temperature sensors at air handler outdoor air intakes shall be considered valid only when the supply fan is proven on and unit is in Occupied Mode or in any other Mode with the economizer enabled.

H. The outdoor air temperature used for optimum start, plant lockout, and other global sequences shall be the average of all valid sensor readings. If there are four or more valid outdoor air temperature sensors, discard the highest and lowest temperature readings.

I. The term “proven” (i.e., “proven on”/ “proven off”) shall mean that the equipment’s DI status point (where provided, e.g., current switch, DP switch, or VFD status) matches the state set by the equipment’s DO command point.

J. The term “software point” shall mean an analog variable, and “software switch” shall mean a digital (binary) variable, that are not associated with real I/O points. They shall be read/write capable (e.g., BACnet analog variable and binary variable).

K. The term “control loop” or “loop” is used generically for all control loops. These will typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the following guidelines shall be followed:

1. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).
2. Do not use the derivative term on any loops unless field tuning is not possible without it.
3. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.

L. All setpoints, timers, dead bands, PID gains, etc., listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.

M. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point, and the software point shall be used in all sequences. Exceptions shall be made for machine or life safety.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Provide control systems consisting of thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified.

B. Provide necessary materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise. Generally, self-contained valves, filter gauges, liquid level controllers and similar instruments, are not to be installed under this section.

C. Unless specified otherwise, provide fully proportional components.

D. Provide all necessary relays and signal boosters to make the system a full and operable system as required by the sequence of operation.

E. Provide for remote access for commissioning of the installation and for future operator flexibility. Coordinate with owner’s IT group to ensure network availability.

PART 3 - EXECUTION CONTROL SEQUENCES

3.1 general requirements

A. User adjustable schedules shall generally control the operation of equipment. Building systems shall be capable of operation 24 hours per day, 7-days per week. Coordinate with the Owner's Facility Management staff for final determination of Occupied/Unoccupied Modes for each system.

B. All setpoints for temperature, pressure, humidity, timing, delays, detection, etc., shall be adj. through the BAS software interface.

C. Coordinate with the Building Owner's Facility Management staff to determine the level of each alarm condition, methods of notification required (email, pager, phone call, etc.) and the staff to be notified based upon the alarm level.

1. Coordinate with Owner to have alarm indications repeat after silencing if sensed condition continues. Coordinate time intervals for repeat of various alarms.
2. All alarms shall include a Time/Date Stamp using the standalone control module time and date.
3. Each alarm can be configured in terms of criticality (Critical/Not Critical), operator acknowledgement (Requires Acknowledgement / Does Not Require Acknowledgement), and conditions required for an alarm to clear automatically (Requires Acknowledgement of a Return to Normal / Does Not Require Acknowledgement of a Return to Normal).
4. An operator shall be able to sort alarms based on level, time/date, and current status.
5. Alarms should be reported with the following information:

    a. Date and time of the alarm.
    b. Level of the alarm.
    c. Description of the alarm.
    d. Equipment tags for the units in alarm.
    e. Possible causes of the alarm, if provided by the fault detection routines.
    f. The source which serves the equipment in alarm it provides resources to a downstream component, such as a chiller providing chilled water to an AHU.

6. Alarm definition shall be as follows unless modified by the Owner. Coordinate with Owner for each alarm the level they desire the BAS to indicate.

    a. Level 1: Critical/Life Safety.
    b. Level 2: Significant Equipment Failure.
    c. Level 3: Non-Critical Equipment Failure/Operation.
    d. Level 4: Energy Conservation Monitor.
    e. Level 5: Maintenance Indication, Notification.

D. Space Setpoints: The following adjustable temperature and CO2 shall be the baseline control setpoints for spaces unless indicated otherwise later in this document. Coordinate with Building Owner's Facility Management staff for final temperature settings to be provided.

Space	Heating, Occupied	Heating, Unoccupied	Cooling, Occupied	Cooling, Unoccupied	CO_2
General	70°F	65°F	75°F	85°F	1,650 ppm
Classrooms	70°F	65°F	75°F	85°F	1,305 ppm
Telecom Rooms	65°F	N/A	70°F	None	1800 ppm
Storage Rooms	50°F	N/A	80°F	85°F	1800 ppm

3.2 EXHAUST FANS

3.3 ERV

1. Energy Recovery Unit shall operate on occupied/ unoccupied schedule via DDC
2. On start open exhaust and outside air dampers (provide operators and dampers as required) and start OA and exhaust air fans. A minimum outside air discharge temperature shall be maintained to 70F. If this is not maintained via the ERV; electric duct coil shall turn on to maintain temperature.
3. Provide graphic with the following:

    a. Occupied/ Unoccupied schedule
    b. Fan speed/ Status
    c. Discharge air temperature and alarm

d. Damper position

END OF SECTION 230993

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

DUCT SERVICE	TYPE/CONSTRUCTION	PRESSURE CLASS
Low pressure supply air from discharge of terminal box/fan to air device.	Galvanized sheet metal (lined as noted on drawings).	+2”
Return air ductwork.	Galvanized sheet metal (lined as noted on drawings).	-2”
Low pressure general building exhaust.	Galvanized sheet metal (lined as noted on drawings).	-2”
Outdoor air intake ductwork.	Galvanized sheet metal.	-2”
Shower, locker room exhaust.	Aluminum with silicone sealant.	-2”
Residential dryer exhaust	Galvanized sheet metal	+2”

B.

C. Exterior insulation of metal ductwork is specified in other Division-23 sections and is included as work of this section.

D. Refer to other Division-23 sections for ductwork accessories, hangers and supports.

1.2 DEFINITIONS

A. Low Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to 2" or less, positive or negative pressure class.

B. Medium or High-Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to greater than 2" positive or negative pressure class.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. References to SMACNA, ASHRAE and NFPA are minimum requirements, the Contractor shall fabricate, construct, install, seal and leak test all ductwork as described in this specification and as shown on the drawings, in addition to these minimum standard references.

D. Codes and Standards:

1. SMACNA Standards: Comply with the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.
2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
3. Air Diffusion Council (ADC) “Flexible Duct Performance and Installation Standards”

E. SMACNA Industrial Construction Standards.

F. Field Reference Manual: Have available for reference at project field office, copy of the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible", and the current SMACNA "HVAC Air Duct Leakage Test Manual".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for ductwork materials and products. Provide product data for manufactured joining systems. Include sound attenuation by octave band for sound rated flexible duct.

B. Shop Drawings: Submit ¼” scaled fabrication and layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Clean Duct Protocol Procedures: Submit written procedures confirming compliance with the clean duct protocol.

D. Record Drawings: At project closeout, submit record drawings of installed systems, in accordance with requirements of Divisions 1 and 23.

E. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Divisions 1 and 23.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Store ductwork inside elevated from floor on pallets and protected from weather, dirt, dust and debris.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acoustical Duct Liner:

    a. CertainTeed Corp.
    b. Johns Manville
    c. Owens-Corning Fiberglas Corp.
    d. Knauf Insulation

2. Flexible Ducts:

    a. Flexmaster
    b. Thermaflex

3. Duct Take Off Fittings

    a. Hercules Industries
    b. Flexmaster
    c. Thermaflex
    d. Ominair

2.2 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains, dents, discolorations, labels, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 653, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Provide flat seam construction where standing seams are a hazard to the Owner's operation personnel.

C. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B 209, Alloy 3003, Temper H14.

2.3 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.

C. Acoustical Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated.

1. Unless otherwise noted, provide 1" thick, 1-1/2 lb density, fiberglass duct liner meeting ASTM C1071 Type I, NFPA 90A and 90B and TIMA (AHC-101) with minimum NRC (noise reduction coefficient) of 0.70 as tested per STM C 423 using an "A" mounting with minimum "K" factor of 0.25. Lining shall be U.L. approved, made from flame attenuated glass fiber bonded with a thermosetting resin with acrylic smooth surface treatment and factory applied edge coating. Materials shall conform to revised NFPA No. 90A Standards, with a maximum flame spread of 25 and maximum smoke development of 50.

D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".

E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/ installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. All PVC coated exhaust ductwork shall be sealed with an approved chemical resistant sealant (P.V.S. #8-WB or approved equal). For outdoor ductwork, sealant shall also be U.V. resistant and weather resistant. Where ductwork is exposed to view in occupied spaces, utilize a clear, paintable duct sealant.

G. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless-steel ductwork, provide matching stainless steel support materials.
2. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.

H. Flexible Ducts: Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 10" W.C. positive, 5” negative for sizes up to 16” through a temperature range of -20°F to 250°F; 5500 fpm rated velocity. Contractor shall assume responsibility for supplying material approved by the authority having jurisdiction.

1. All flexible duct shall be rated for sound attenuation. Inner core shall be black CPE supported by a galvanized steel helix, with minimum R-6 insulation and metalized reinforced outer jacket.

a. Flexmaster Type 1M

2. Sound attenuation shall be as scheduled below:

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)							
Octave Band	125	250	500	1000	2000	4000	
8" Diameter	5	16	17	18	16	11	

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)							
12" Diameter	8	17	14	18	14	11	

3. Non-insulated flexible ducts shall be the same as insulated less the insulation and outer jacket.

I. Duct Take Off Fittings to Individual Air Inlets & Outlets: Provide conical spin-in fittings at flexible or round sheet metal duct takeoffs. Where specifically shown on drawings, where the duct dimension does not allow for a conical spin-in, or at Contractor's option, provide 45° inlet rectangular to round duct take off fittings, with factory applied gasket. Fittings shall include butterfly type manual volume damper with locking quadrant handle and 2” insulation stand-off. Shafts shall be solid metal, rolled metal shafts are not acceptable.

J. Duct take off fittings to air terminals: same as for individual air inlets and outlets, less the damper.

K. All fasteners and hardware for stainless steel ductwork and PVC coated ductwork shall be made of stainless steel.

2.4 FABRICATION

A. Fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match (-) mark sections for reassembly and coordinated installation.

B. Fabricate ductwork of gauges and reinforcement complying with the latest SMACNA "HVAC Duct Construction Standards". Minimum 26 GA where ducts are within corridors.

C. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.

D. If manufacturer flange joining systems are used as part of the reinforcing, the EI rating and rigidity class shall be equivalent to the reinforcing requirements of the standard. Submit manufacturer's product data.

E. Aluminum duct shall be fabricated using the aluminum thickness equivalence table in the standard. Simply increasing the thickness by two gauges is not acceptable.

F. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows and offsets with center-line radius equal to 1.5 times the associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. 90° mitered elbows with turning vanes may be used where specifically shown on drawings. Mitered elbows or offsets of other than 90° shall not be used. Two 90° mitered elbows shall be separated by a minimum of 2 equivalent duct diameters. Use radiused “Ogee” for offsets less than 90°. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers. Divided flow fittings shall be 45° inlet branches, stationary splitters and elbows, or as shown on drawings.

G. Elbows with sharp throat and radius heel are not allowed.

H. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements. A

I. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive and fasten with mechanical fasteners. Provide sheet metal nosing on all leading edges preceded by unlined duct, at duct openings, and at fan or terminal unit connections.

2.5 ROUND and flat oval DUCTWORK

A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized. Spiral lockseam construction. Individual runouts to air devices may be longitudinal seam.

B. Gauge: In accordance with the SMACNA “HVAC Duct Construction Standards”, minimum 26 gauge.

C. Elbows: One piece construction for 90 deg. and 45 deg. elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Radius to centerline shall be 1.5 times duct diameter. Spot welded and bonded construction. Elbows on runouts to individual air devices may be pleated or adjustable.

D. Divided Flow Fittings: 90 deg. tees, constructed with branch spot welded and bonded to duct fitting body, with minimum 2" flange shaped to fit main duct.

2.6 factory Built grease exhaust duct systems

A. Codes and Standards

1. UL1978 Test Standard – Grease Ducts for Restaurant Cooking Appliances
2. NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations

B. Pipe joints shall be held together by means of formed vee bands and sealed with 3M Fire Barrier 2000+ grease duct sealant

C. Provide a round hood collar or a square-to-round transition for connection to the hood.

D. Provide a fan adapter plate for curb mounted fans

E. Listed single wall grease exhaust duct for use with type 2 kitchen hoods:

1. Factory prefabricated, liquid tight single wall type, listed for venting of grease laden air from kitchen hoods required grease duct as described in NFPA 96
2. Rated for continuous operation at 500°F and intermittent operation at 2000°F
3. All components of the grease duct system shall be provided by the manufacturer to ensure the system meets the requirements of the listing duct supports, guides, fittings, cleanouts, and expansion joints required to install the duct.
4. The duct shall be constructed of 304, 316, or 430 stainless steel

    a. 6-in through 36-inch diameter materials: 0.035 inches thick
    b. 38-in through 48-inch diameter materials: 0.048 inches thick

5. The duct assembly is tested and listed to 18 inches clearance to combustibles in 6-to-48-inch diameters and shall be equivalent to welded steel duct for use within enclosed fire rated shafts at code prescribed clearances to fire rated shaft walls

F. Listed double wall grease exhaust duct for use with Type 1 kitchen hoods:

1. Factory prefabricated, liquid tight double wall type, UL listed for venting of grease laden air from Type I rated kitchen hoods requiring grease duct as described in NFPA 96.
2. Rated for continuous operation at 500°F and intermittent operation at 2000°F
3. All components of the grease duct system shall be provided by the manufacturer to ensure the system meets the requirements of the listing including duct supports, guides, fittings, cleanouts, and expansion joints required to install the duct.
4. Grease duct shall conform to requirements of ASTM E119 Fire Engulfment Test, ASTM E814 3-hour fire Stop Test, and shall be listed by the following agencies with the associated Listed reports:

    a. UL 1978 (File MH8251) – Grease Ducts for Restaurant Cooking Appliances
    b. UL 2221 (File R15388) – Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies
    c. UL Evaluation Report UL ER15388-01 – UL Evaluation of 3G and 4G Grease Duct Systems.
    d. UL 103HT (MH8251) – Standard for factory-built chimneys and building appliances, and solid fuel cooking appliances.

5. The duct sections shall be constructed of an inner wall and an outer wall with ceramic fiber insulation between the walls.

    a. The inner wall shall be constructed of 304, 316, or 430 stainless steel. 6-in through 36-in diameter: 0.035-inch-thick inner wall.
    b. The outer wall shall be constructed of aluminized steel, 304 or 316 stainless steel. 6-in through 36-in diameter: 0.024-inch-thick outer wall
    c. The duct shall include a 3” thickness of body soluble ceramic fiber insulation between the inner and outer walls

6. The duct assembly is Tested and Listed to 0 inches clearance to combustibles.
7.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL DUCTWORK:

A. Duct Sealing:

1. Seal all low-pressure ducts to SMACNA Seal Class "B".
2. Seal all medium and high-pressure ducts to SMACNA Seal Class "A".

B. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with

suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.

C. Construct ductwork to schedule of operating pressures as shown on drawings.

D. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

E. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

F. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

G. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

H. Slope shower, locker room, and high moisture ductwork down to air device.

I. Penetrations: Where ducts pass through fire rated walls and do not contain fire or smoke dampers, protect with fire stop material installed in accordance with its listing. Where ducts pass through interior partitions or exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four sides by at least 1-1/2". Fasten to duct only. Where ducts penetrate non-fire rated, mechanical, electrical or acoustically sensitive walls, provide ½” to ¾” annular space between duct and wall, pack annular space with mineral wood insulation, and caulk both sides with non-hardening acoustical sealant.

J. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

K. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards and Industrial Construction Standards.

L. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.3 installation of duct take-off fittings

A. Fully seal all joints.

B. Sheet metal screw regulator arm to duct after balance is complete. Mark and date position of regulator arm.

C. Insulation over regulator arm is not required.

3.4 INSTALLATION OF DUCT LINER

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.5 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6' - 0".

B. Installation: Install in accordance with SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible" and ADC “Flexible Duct Performance and Installation Standards”.

C. Full inside diameter of flexible duct shall be maintained. Support to prevent kinking. Do not bend ducts across sharp corners of building elements such as joists.

D. Flexible duct shall not be installed above an inaccessible ceiling unless the air device is set in a frame allowing access to both ends of the flexible duct.

E. Install ducts fully extended. Do not install in the compressed state.

3.6 FIELD QUALITY CONTROL

A. Leakage Tests: Conduct duct leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.

B. General:

1. Ductwork pressure tests shall be observed by Architect/Engineer prior to installation of insulation.
2. Ductwork systems in ±3" W.G. pressure class and higher, regardless of system operating pressure, shall be tested in their entirety for leaks. Arbitrary sections of ductwork in ±2" W.G. and lower pressure class, regardless of system operating pressure, shall be tested as required by Architect/Engineer.
3. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof.

C. Test Equipment:

1. Portable rotary type blower or tank type vacuum cleaner with control damper. Equipment shall have sufficient capacity to properly test a reasonably large duct system section. Equipment shall have been calibrated within 2 years of the testing.
2. Orifice assembly consisting of straightening vanes and calibrated orifice plate mounted in a straight tube with properly located pressure taps.
3. Two (2) U-tube manometers, one to measure drop across calibrated orifice and one to measure S.P. in duct being tested. Provide low differential pressure Dwyer magnehelic gauges for low leak testing in lieu of U-tube manometers.
4. Provide Dwyer magnehelic gauge with 0-.25" W.C. range for testing 0% leakage ductwork.

D. Testing Pressures and Permissible Leakage:

1. Test pressure shall be equal to the construction class. Negative pressure duct shall be tested at the equivalent positive pressure.
2. Allowable leakage shall be determined from the following equation (or figure 4-1 in the above referenced Standard):
   $F = C_L (P)^{.65}$

   Where: F = Allowable leakage factor CFM/100 Sq. Ft.
   C_L = Leakage Class
   P = Test pressure inches W.C.

3. Leakage class shall be as follows:

   a. Seal class A, Round or oval duct, $C_L = 3$.
   b. Seal class A, Rectangular duct, $C_L = 6$.
   c. Seal class B, Round or oval duct, $C_L = 6$.
   d. Seal class B, Rectangular duct, $C_L = 12$.
   e. Seal class C, Round or oval duct, $C_L = 12$.
   f. Seal class C, Rectangular duct, $C_L = 24$.

4. Record all tests using the procedure and forms in the above referenced standard.
5. All plenums and casings shall be tested by pressuring to the pressure class indicated and visually observing leakage and panel deflection.

   a. No noticeable leakage shall be allowed.
   b. Deflection shall be less than 1/8" per foot.

3.7 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where required for service, maintenance and inspection of ductwork accessories. See section 233300.

3.8 ADJUSTING AND CLEANING

A. Protection:

1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
2. Cover all stored ducts to protect from moisture, dust or debris.
3. Maintain a cover on all ends of installed ductwork at all times, except when actually connecting additional sections of duct.

B. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.

1. Duct liner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
2. Duct liner in installed ductwork which has become wet must be completely removed and replaced.

3. Torn duct liner may be repaired by coating with adhesive if damage is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

C. Protect lined duct from becoming wet or torn.

D. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

E. Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 233113

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

C. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers" and U.L. Standard 555S "Motor-Driven Fire/Smoke Dampers."

D. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

E. SMACNA Compliance: All exhaust ducts comply with "Fire Damper and Heat Stop Guide".

F. All fire dampers, smoke dampers, fire/smoke dampers and radiation dampers shall meet the latest local building code requirements.

G. Actuators shall be UL 2043 listed for low smoke generation if installed in an environmental air moving plenum as required by NFPA 70 and the International Mechanical Code.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components. Include details of construction equipment and accessories being provided.

C. Submittals for all damper types specified in this section shall include a schedule for each damper indicating net free area, actual face velocity and pressure drop (at sea level) based on net free area & the maximum air quantity which will be passing through the damper. Submittals without this information will be rejected.

D. Submit Heresite duct/equipment protective coating product data sheets and application instruction.

E. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

F. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Dampers:

a. Greenheck
b. AWV
c. Air Balance, Inc.
d. Anemostat
e. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
f. Louvers & Dampers, Inc.
g. Penn Ventilator Co.
h. Pottorff
i. Ruskin
j. Nailor

2. Turning Vanes:

a. Aero Dyne Co.
b. Airsan Corp.
c. Barb-Aire
d. Duro Dyne Corp.
e. Environmental Elements Corp.; Subs. Koppers Co., Inc.
f. Hart & Cooley Mfg. Co.

3. Flexible Connections:

a. Duro Dyne Corp.
b. Ventfabrics, Inc.
c. General Rubber Corp. (Process & Exhaust Only)

2.2 MANUAL VOLUME DAMPERS

A. Low Pressure Rectangular Dampers (less than 2000 FPM and under 2" W.C. S.P. Differential):

1. For 12" in height or larger, use multiple opposed blade type and close fitted to ducts. The frame and blades shall be constructed of 16 ga. galvanized steel with plated steel shaft mounted with synthetic bearings. Linkage shall be in-jamb fixed type located outside the airstream made of plated steel tie bar and crank plates, with stainless steel pivots. Damper panels shall not exceed 48" wide. Provide jack shafting when duct size required is greater than 48" wide. Provide notched shaft end indicating damper position, locking quadrant to fix damper position and handle. Provide standoff bracket for insulated ducts. For flat oval and round ductwork, provide type C housing.
2. For ducts less than 12" in height, frame shall be 18 ga. blade galvanized steel, steel axle with synthetic bearings locking quadrant handle and notched shaft end indicating damper position. Provide standoff bracket for insulated ducts.

B. Low Pressure Round Dampers (less than 1800 FPM and under 1" W.C. S.P. differential):

1. For low pressure spin-in fitting dampers serving individual returns/diffusers, see 23 31 13.
2. Dampers 4" diameter through 18" diameter shall be 20 ga. galvanized steel frame and blade, utilize multi-blade square dampers with transitions for ducts over 18" diameter.
3. Axle shaft shall be plated steel with retainers mounted on synthetic bearings with notched end shaft indicating damper position, locking quadrant and handle. Provide standoff brackets for insulated ducts.

    a. Greenheck MBDR-50 or approved equivalent.

2.3 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated 22-gauge, single blade or 24 gauge double bladed 4-1/2" radius, 3-1/4" spacing turning vanes and type 2, 4-1/2" wide runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards" Fig 2.3.

B. Turning vanes as a part of PVC coated air systems shall be PVC coated.

C. Do not use trailing edge turning vanes.

2.4 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

C. Quadrant Locks: Provide for each manual volume damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.5 DUCT ACCESS DOORS

A. Access Doors for Low Pressure Rectangular Duct: Construct of same or greater gauge as ductwork served, provide double wall insulated doors for insulated ductwork. Exposed insulation adhered to door is not acceptable. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. All access doors shall have gasket and will be airtight. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Where a hinged door cannot be fully opened a removable door may be used.

B. Access Doors for Medium and High-Pressure Rectangular Duct: Insulated double wall round door and frame arranged for "Spin-In" installation, with continuous gasket in frame for door. Leakage of less than 0.5 cfm at 6" W.G.

C. Flexmaster "Inspector Series Spin Door" or equivalent.

D. Access Doors for Round Duct 20" and Less: Sandwich type door, constructed of an insulated double wall outer door connected to gasketed inner plate carriage bolts with hand knobs, and formed to fit the radius of the duct.

    1. Ductmate "Sandwich" or equivalent.

E. Access Door for Round Duct Greater Than 20": 18" round insulated double wall access door in gasketed frame, attached to duct section similar to tee fitting.

F. Access Doors for Flat Oval Duct: Use door specified for medium and high-pressure rectangular duct in flat portion, use door specified for round duct in curved portion.

G. Access Doors for use in Type I commercial cooking hood ductwork (grease exhaust): 16 ga Black Steel, or Stainless steel where used on stainless steel ducts. High temp ceramic fiber gasket rated to 2300 °F. Inner frame to support duct cutout and accept studs and bolts. Multiple studs with wing nut or wing bolts on door. Provide studs as required to accept exterior rated duct wrap to meet wrap assembly requirements. Provide handles. Door assembly shall be rated for temperatures up to 2300°F as required by NFPA 96 and shall be UL listed as a Hood and Duct Accessory. Flame Gard Grease Duct Access Door or equivalent.

H. All access doors in other than standard galvanized steel duct systems shall be of the same material or with the same coating as the duct system.

2.6 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment. Shelf life shall be verified to not exceed six (6) months. Any sign of cracking on interior or exterior shall be cause for replacement immediately.

B. Use the following product types for each application accordingly:

1. Indoor Equipment Non-Corrosive Air Systems: Heavy glass fabric, double-coated with DuPont's NEOPRENE, non-combustible fabric, fire retardant coating with good resistance to abrasion and flexing. Fabric shall be 30 oz per square yard, capable of operating at -10ºF to 200ºF, waterproof, airtight, 6 inches wide, complies with NFPA 90 and UL Standard #214. "Ventglas" Model as manufactured by VentFabric, Inc.
2. Outdoor Equipment Non-Corrosive Air Systems (exposed to weather and sun): Heavy glass fabric, double-coated with DuPont's HYPALON, non-combustible fabric, fire retardant coating with superb resistance to sunlight, ozone and weather which has documented 20-year-old exposure tests. Fabric shall be 26 oz per square yard, capable of operating at -10ºF to 250ºF, waterproof, airtight, 6 inches wide, complies with NFPA 90 and UL Standard #214. "Ventlon" Model as manufactured by VentFabrics, Inc.
3. High Temperature Non-Corrosive Air Systems: Heavy glass fabric coated with silicone rubber, non-combustible fabric, fire retardant coating, capable of operating and maintaining flexibility between temperatures of -25ºF to 500ºF. Fabric shall be 16 oz. per square yard, waterproof, airtight, 6 inches wide, complies with NFPA 90, UL Standard #214. "Ventsil" Model as manufactured by VentFabrics, Inc.
4. Indoor Corrosive Air System: Heavy glass fabric coated with DuPont's Teflon fluorocarbon resins, capable of operating between temperatures of - 20ºF and 500ºF. Fabric shall be 14 oz per square yard, watertight, air tight, chemically resistant to most chemicals including but not limited to sulfuric acid, acetic acid, chlorine, dimethyl ether, xylene, hexane, ozone, nitric acid, butyl acetate, ammonia gas and liquid, acetone, mercury, cyclohexane, methanol, 6 inches wide "Ventel" model as manufactured by VentFabrics, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 deg. elbows in supply, return and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

E. Provide duct access doors whether shown or not for inspection and cleaning upstream of all coils, fans, automatic dampers, fire dampers (minimum 16" x 24" in ducts larger than 18"), fire/smoke dampers, duct smoke detectors and elsewhere as indicated. Review locations prior to fabrication. Provide multiple access doors for large ductwork to provide adequate reach to equipment.

F. Install fire dampers and smoke dampers in accordance with manufacturer’s instructions.

G. Provide fire dampers and smoke dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.

H. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing.

I. Provide balancing dampers on high pressure systems where indicated. Use splitter dampers only where indicated on Drawings.

J. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration. Provide matching flanged backing frame with flexible connector where flanged fan connections are provided.

3.3 COORDINATION

A. Coordinate with installers of other work to ensure that operators, reset devices, and fusible links are accessible at all fire, smoke, and fire/smoke dampers.

B. Show access space on coordination drawings. Locate over lay-in ceilings and above corridors wherever practical.

C. Order right/left/top/bottom arrangement as required to minimize field modifications.

3.4 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories after installation to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

B. After installation, test every fire, smoke, and fire/smoke damper for proper operation, provide letter to the Architect/Engineer certifying this work is complete and all dampers are functioning properly.

1. Verify that each fire/smoke damper closes when the associated duct or space detector is tripped. Verify that air handlers shut down and outside air dampers close as dictated by the control sequence.
2. Verify that air supply units shut down when smoke is detected by the associated duct detector. Verify that outside air dampers and system fire/smoke dampers close as dictated by the control sequence.
3. Report any detectors or dampers that are malfunctioning. Report any discrepancies from the control sequence.

3.5 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division-23 section "Mechanical Identification".

C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.6 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 233300

SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of air handling equipment work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Refer to other Division 23 sections for vibration control; control system; sequence of operation; testing, adjusting and balancing.

C. Refer to Division 26 section for the following work; not work of this section.

1. Power supply wiring from power source to power connections at air handling units.

D. Refer to Section 230505 Paragraph 2.6 for requirements of sheaves and belts for critical areas.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air handling equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. Fans Performance Ratings: Establish flow rate, pressure, power air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.
2. UL Compliance: Provide air handling equipment which are listed by UL and have UL label affixed.
3. UL Compliance: Provide air handling equipment which are designed, manufactured, and tested in accordance with UL 805 "Power Ventilators".
4. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.
5. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating."
6. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be defined in OSHA Regulation 1910.7.
7. Electrical Component Standards: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for air handling equipment including specifications, capacity ratings, dimensions, weights, materials, operating & service/access clearance accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air-handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are manufacturer-installed and portions to be field-installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.

E. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals in accordance with requirements of Division 23.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.

B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate the size and location of structural steel support members.

1.6 EXTRA MATERIALS

A. Furnish one additional complete set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Centrifugal Fans:

a. Buffalo Forge Co.
b. ILG Industries, Inc.
c. Loren Cook Co.
d. New York Blower Co.

e. Trane Co.
f. Twin City Fan and Blower Co.
g. Greenheck
h. Carnes
i. PennBarry

2. Prefabricated Roof Curbs

a.
b. Pate Co.
c. Thybar Corp.
d. AES Industries, Inc
e. Curbs Plus, Inc
f. Custom Solution Roof and Metal Products
g. Greenheck Fan Corporation.
h. KCC International
i. LM Curbs
j. Roof Products, Inc

2.2 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.4.

D. Belts: Oil-resistant, nonsparking, and nonstatic.

E. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions. Provide energy efficient motor.

1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Class II fans shall be provided, except when total static pressure exceeds 4 in. w.c. For TSP greater than 4 in. w.c., Class III fans shall be provided.

G. Shaft Bearings: Provide type indicated, having a median life "Rating Life" AFBMA L10 of 40,000 calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

H. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

I. Vibration: Provide vibration isolators as specified in Section 230548 and as indicated.

2.3 CENTRIFUGAL FANS

A. General Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

B. Housings: Fabricated from formed and reinforced galvanized steel panels to form curved scroll housings with continuously welded or deep-locked seams and access doors or panels to allow access to internal parts and components.

1. Inlet Cones: Spun metal.
2. Duct Connections: Flanged.
3. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

C. Fan Wheels: Single-width, single-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.

D. Fan Wheels: Double-width, double-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.

1. Blade Materials: Steel.
2. Blade Type: Backward-curved, flat-plate type.
3. Blade Type: Backward-curved, airfoil type.
4. Blade Type: Forward-curved, airfoil type.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow- block type ball bearings.

F. Accessories: The following accessories are required.

1. Scroll Bypass Dampers: Aluminum, opposed, airfoil blades with extruded vinyl seals on blades, low-friction bearings, and positive control linkage for manual or automatic operation.
2. Scroll Housing Access Doors: Latch-type handles; flush-mounted for uninsulated housings and raised-mounted for insulated housings.
3. Inlet Vanes: Radial vanes with linkage for manual or automatic operation.
4. Double-Width Fans Inlet Vanes: Connected for single operator.
5. Inlet Screens: Heavy wire mesh screens, mounted inside of shaft bearings.
6. Discharge Dampers: Heavy-gauge steel opposed blade design, with linkage for manual or automatic operation.
7. Drain Connections: Threaded, ¾” NPS, capped nipple installed at lowest point of housing.
8. Shaft Cooler: Metal disc between bearings and fan wheel, designed to dissipate heat from shaft.
9. Spark-Resistant Construction: AMCA construction option A, B, or C as indicated.
10. Shaft Seals: Air-tight seals installed around shaft on drive side of single-width fans.
11. Special Coatings: Provide protective coatings on fans as indicated.
12. Extended Grease Lines: Extend grease lines from bearings to a convenient, visible location and terminate with grease fitting.

2.4 CENTRIFUGAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gauge, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable ½” mesh, 16-gauge, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.
4. Roof Curbs: Prefabricated, heavy-gauge, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

a. Overall Height: 12 inches.

2.5 PREFABRICATED ROOF CURBS

A. Furnish and install roof curbs as scheduled for duct openings through the roof and for exhaust fan support. The curbs shall be galvanized steel self-flashing type. If the curbs are to have sound attenuation qualities, they shall be not less than those catalogued for the equipment specified. Roof curb height shall be coordinated with the G.C. to be 12” above finished roof in the location of the equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units using vibration control devices as indicated. Vibration control devices are specified in Division 23 Section "Vibration Controls."

1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. Roof curb height shall be coordinated with the G.C. to be 12” above finished roof in the location of the equipment.

    a. Installation of roof curbs is specified in Division 7.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections on inlet and outlet duct connections with flexible connections.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Ensure that rotation is in direction indicated and intended for proper performance. Do not proceed with centrifugal fan start-up until wiring installation is acceptable to centrifugal fan Installer.
2. Temperature control wiring and interlock wiring are specified in Division 23.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

B. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.5 ADJUSTING, CLEANING, AND PROTECTING

A. Startup, test and adjust air handling equipment in presence of manufacturer's authorized representative.

B. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.6 SPARE PARTS

A. General: Furnish to Owner with receipt one spare set of belts for each belt driven air handling equipment.

3.7 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
2. Replace fan and motor pulleys as required to achieve design conditions.
3. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.8 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 23 Section "Basic Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 233400

SECTION 233713 – DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall registers and grilles.

C. Refer to other Division 23 sections for ductwork, duct accessories, testing and balancing; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. AHRI Compliance: Test and rate air outlets and inlets in accordance with AHRI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number, furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Samples: Submit 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

E. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 23.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory- fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Diffusers, Registers and Grilles:

a. Anemostat
b. Price
c. Carnes
d. Krueger
e. Titus
f. Metal-Aire
g. Carnes
h. Nailor

2.2 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on air device schedule.

2.3 REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction, which will contain each type of wall register and grille.

D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on air device schedule.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including duct work and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.3 SPARE PARTS:

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

SECTION 237200 – AIR TO AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of energy recovery units work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of energy recovery units specified in this section include the following:

1. Fixed Plate Heat Exchangers.

C. Refer to other Division 23 sections for piping; specialties; pumps; ductwork; temperature controls; testing and balancing; required external to energy recovery units for installation; not work of this section.

D. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on energy recovery units. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
2. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

E. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:

1. Control wiring between field-installed controls, indicating devices, and energy recovery unit control panels.

a. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of energy recovery units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ASHRAE Compliance: Provide capacity ratings for energy recovery devices in accordance with ASHRAE 84 "Methods of Testing Air-to-Air Heat Exchangers".
2. NRCA Compliance: Provide roof curbs for roof mounted equipment constructed in accordance with recommendations of NRCA.
3. AHRI Compliance: Test and rate energy recovery units in accordance with AHRI 1060 "Standard for Air-to-Air Heat Recovery Equipment".

4. ASHRAE Compliance: Design, construct, and install heat pipe heat exchangers in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
5. NFPA Compliance: Construct and install energy recovery units incorporating electrical equipment in accordance with NFPA 70 "National Electrical Code".
6. UL Labels: Provide energy recovery units ancillary electrical components which have been listed and labeled by UL.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

E. Maintenance Data: Submit maintenance data and parts list for each energy recovery unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 23.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle energy recovery units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store energy recovery units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading energy recovery units and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Fixed Plate Heat Exchangers

    a. Exothermics Corp.
    b. Temp-X-Changer Energy Recovery Div.; United Air Inc.
    c. Heatex

d. RenewAire

2.2 FIXED PLATE HEAT EXCHANGERS

A. General: Provide as indicated, factory-assembled and tested fixed plate heat exchangers, of capacity as scheduled.

B. Casing: Construct of 0.040" thick aluminum sheet, with ends flanged for duct connections. Provide bedding material of epoxy or refractory cement.

C. Plates: Construct of 0.010 to 0.030" thick aluminum embossed plates, having formed indentations to insure proper spacing and rigidity. Seal plates with non-toxic epoxy bedding material, to provide airtight joints. Provide nominal 0.125 to 0.500" spacing between plates. Arrange plates for counterflow air flow, with air stream direction as indicated.

D. By-Pass: Construct within casing, by-pass plenum, with 16 ga. galvanized steel gasketed face and by-pass dampers, with rods extended outside casing for damper operator and linkage. Controls; not work of this section.

E. Water wash: Construct of 1" copper tubes manifolded to individual 1/4" spray tubes, inserted through full length of exhaust air passage. Modify plate configuration for water wash. Provide threaded drain connection in casing bottom.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which energy recovery units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install energy recovery units where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices to ensure that units comply with requirements and serve intended purposes.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.3 INSTALLATION OF FIXED PLATE HEAT EXCHANGERS

A. General: Comply with fixed plate heat exchanger manufacturer's instructions for installation, except as otherwise indicated.

B. Install so supply and exhaust flow in opposite directions.

C. Provide access doors in both supply and exhaust ducts both upstream and downstream for access to heat exchanger.

D. Install floor mounted units on 4" high concrete pad.

E. Start-up fixed plate heat exchangers in accordance with manufacturer's start-up instructions and in presence of manufacturer's representative.

3.4 TESTING

A. Upon completion of installation of energy recovery units, and after air-side and water-side balancing has been completed, test units to ascertain percent effectiveness of heat transfer device. Adjust units for maximum effectiveness.

1. Furnish test report, similar to SMACNA Form, ER-1-78 include report in each copy of maintenance manual.

3.5 EXTRA STOCK

A. Provide one complete extra set of filters for each filter bank in energy recovery units. Install new filters at completion of energy recovery system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Provide one spare set of belts for each belt-driven fan in energy recovery units, obtain receipt from Owner that belts have been received.

END OF SECTION 237200

SECTION 238000 – DECENTRALIZED HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of terminal unit work is indicated on drawings and schedules, and by requirements of this section.

B. Types of terminal units required for project include the following:

1. Electric duct heaters.

C. Refer to other Division 23 sections for piping; ductwork; testing, adjusting and balancing of terminal units; not work of this section.

D. Refer to Division 26 section for the following work; not work of this section.

1. Power supply wiring from power source to power connection on terminal units.
2. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:

a. Control wiring between field-installed controls, indicating devices, and terminal unit control panels.

1) Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

E. Refer to other Division 23 sections for automatic temperature controls not factory installed, required in conjunction with terminal units; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. I=B=R Compliance: Test and rate baseboard and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.
2. AHRI Compliance: Provide coil ratings in accordance with AHRI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".
3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".
4. AHRI Compliance: Test and rate fan-coil units in accordance with AHRI Standard 440 "Room Fan-Coil Air Conditioners".
5. UL Compliance: Construct and install fan-coil units in compliance with UL 883 "Safety Standards for Fan Coil Units and Room Fan Heater Units".

6. UL Compliance: Provide electrical components for terminal units, which have been listed and labeled by UL.
7. AHRI Compliance Test and rate unit ventilators in accordance with AHRI Standard 330 "Unit Ventilators".
8. AGA Compliance: All gas fired heating equipment shall be AGA Design Certified.
9. Electric Heating Equipment: All equipment with a heating coil capacity exceeding a 48-amp rating shall have the heating elements subdivided and protected by an overcurrent protection device rated at not more than 60 amps. Equipment not exceeding 48 amps shall also have overcurrent protection. Overcurrent protection devices shall be factory wired and installed in accordance with the National Electric Code. All equipment shall be factory assembled and wired in accordance with the National Fire Protection Association and shall be listed by Underwriters' Laboratories.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, for terminal units showing dimensions, capacities, ratings, performance characteristics, gauges and finishes of materials, and installation-startup instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating terminal unit dimensions, weight loading, required clearances, construction details, field connection details and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 23.

E. Samples: Submit 3 samples of each type of cabinet finish furnished.

F. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, control, accessories, "troubleshooting" maintenance guide, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 23.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.

B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Electric Duct Heaters

a. Brasch
b. Q Mark
c. Indeeco
d. Markel
e. Raywall
f. Thermolec

2.2 ELECTRIC DUCT HEATERS

A. Electric duct heaters shall be electric resistance type. Controlling contactors shall be magnetic relay type and shall be wired so as to de-energize the heater circuits. All contactors and over current protection devices shall be factory wired and installed in accordance with the National Electric Code, the National Fire Protection Association, and Underwriters' Laboratories.

B. Coil shall be non-stratifying design such that each stage of heat is spread over the entire face of the coil.

C. Coil shall have a built-in pressure differential type air flow safety switch and auto-reset thermal overload protection wired into the control circuit, and manual-reset thermal overload protection wired into the power circuit to the coil. Heater shall include line voltage disconnect switch.

D. Provide a built-in fused control power transformer.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

B. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.3 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory- finished cabinets, using finish materials furnished by manufacturer.

C. Install new filter units for terminals requiring same.

3.4 START-UP

A. Start-up, test, and adjust terminal units in accordance with manufacturer's published start-up instructions. Adjust for proper airflow where applicable.

END OF SECTION 238000

SECTION 238126 – DUCTLESS SPLIT SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The air conditioner system shall be a ductless split system consisting of a horizontal discharge, outdoor unit, and a matched capacity indoor unit that shall be equipped with controller type as indicated on the drawings.

B. Refer to other Division 23 Sections for automatic temperature controls not factory-installed and required for conjunction with packaged heating and cooling units; not work of this Section.

C. Electrical Work: Refer to Division 23 Sections requirements of electrical provisions of mechanical work.

1.2 REFRIGERANTS

A. All refrigerants used for each condensing unit shall be on the latest EPA list of approved refrigerants & environmentally friendly.

B. No CFC based refrigerants shall be used.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. The units shall be tested by and bear the label of a Nationally Recognized Testing Laboratory.

C. Performance Requirements: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with AHRI Standards.

D. Codes and Standards:

1. AHRI Compliance: Provide capacity ratings for packaged heating and cooling units in accordance with AHRI Standard 210/240 "Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment".
2. ASHRAE Compliance: Construct refrigerating system of packaged heating and cooling units in accordance with ASHRAE Standard 15 "Safety Standard for Refrigeration Systems, most recent edition".
3. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the UL or ETL label.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to packaged heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of packaged heating and cooling units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field- installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 23.

E. Maintenance Data: Submit maintenance data and parts list for each packaged heating and cooling unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 23.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle packaged heating and cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged packaged heating and cooling units or components; replace with new.

B. Store packaged heating and cooling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading packaged heating and cooling units and moving units to final location for installation.

D. Units shall be broken down and shipped in components as field conditions require. A factory authorized representative shall inspect the final installation to certify that the unit has been reassembled per factory recommendations and specifications.

1.6 WARRANTY

A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, limited by style of indoor unit, system cooling capacity size range and low ambient operation, provide products by one of the following:

1. Mitsubishi.
2. Daikin.

2.2 Ductless Split-systems (1.5 to 3.5 tons nominal)

A. Indoor Units

1. General: Provide factory-assembled and tested packaged units as indicated, consisting of casing, compressor, evaporator, fans, filters, and unit controls. Provide capacities and electrical characteristics as scheduled.
2.
3. Wall-Mounted:

a. Cabinet: Enameled steel with removable panels on front and ends and discharge drain pans with drain connection.
b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and with thermal-expansion valve.
c. Fan: Direct drive, centrifugal fan.
d. Fan Motors: Comply with requirements in Section 230507 Motor, Drives, Motor Controllers and Electrical Requirements for Mechanical Equipment.

1) Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.

e. Filters: Permanent, cleanable.

4. Suspended (Exposed to View):

a. Cabinet: Horizontal suspended fan coil unit. Cabinet shall have adjustable air distribution outlet. Return air shall be through the bottom panel. Cabinet shall be insulated
b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with electronic-expansion valve.
c. Condensate Pan: Provide condensate pan with connection to drain.
d. Electric heat option where specified.
e. Fan: Direct drive, centrifugal fan and integral condensate pump.
f. Fan Motors: Comply with requirements in Section 230507 Motor, Drives, Motor Controllers and Electrical Requirements for Mechanical Equipment.

1) Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.

g. Filters: High Efficiency MERV 8 minimum.

B. Outdoor Units:

1. General: Provide factory-assembled and tested packaged units as indicated, consisting of casing, compressors, evaporator, fans, filters, and unit controls.
2. Provide capacities and electrical characteristics as indicated on drawings.
3. Casing: Steel, finished with baked enamel with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gauge ports on exterior of casing.
4. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Inverter controlled scroll.
    b. Refrigerant Type: R-410A.

5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid sub cooler. Provide with manufacturer's optional coil coating for coastal areas.
6. Fan: Aluminum-propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Mounting Base: Polyethylene.
9. Units specified for heat pump operation shall be provided with reversing valve and related controls to switch to heating mode.
10. Unit shall be capable of operating to the low ambient conditions indicated on the drawings.

C. Accessories:

1. Provide wired remote wall-mounted controller for each evaporator unit to control compressor and evaporator fan and shall control on/off operation, temperature set points and other settings.
2. Automatic-reset timer to prevent rapid cycling of compressor.
3. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
4. Additional refrigerant for extended line lengths as defined by the manufacturer.
5. Integral condensate pump for indoor unit, either factory-supplied/contractor-installed or provided complete by Division 23 Contractor.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which packaged heating and cooling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PACKAGED HEATING AND COOLING UNITS

A. General: Install packaged heating and cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install units from wall or overhead structure as required by manufacturer’s installation instructions.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
2. Ductwork: Refer to Division 23 Section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
3. Connect all duct connections to unit with flexible connection. Provide manual damper, quadrant and lock.

D. Air-Cooled Condenser Piping: Refer to Division 23 Section "Basic Piping Materials and Methods". Connect liquid and hot gas piping to unit as indicated by manufacturer’s installation instructions included required piping accessories.

E. Drain Piping: Connect indoor unit drain to nearest indirect waste connection. Provide trap at drain pan; construct at least 1.5" deeper than fan pressure in inches of water.

3.3 FIELD QUALITY CONTROL

A. General: Start-up ductless split system units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.4 TRAINING

A. Schedule a minimum of 4 hours of training with Owner. The manufacturer’s representative and the Division 23 contractor shall be present. The training shall be coordinated by the Division 23 contractor and the Owner in conjunction with the other mechanical equipment on the project.

B. Training:

1. Train the Owner's maintenance personnel on start-up and shut-down procedures, troubleshooting procedures, and servicing and preventative maintenance schedules and procedures. Review with the Owner's personnel, the contents of the Operating and Maintenance Data specified in Division 1 and Section 230500.
2. Schedule training with Owner through the Architect/ Engineer with at least 7 days prior notice.

3.5 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts for each packaged heating and cooling unit:

1. One set of filters for each unit.

END OF SECTION 238126

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 26 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

C. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26 and Division 28. It expands and supplements the requirements specified in sections of Division 1 through 50.

1.3 ELECTRICAL INSTALLATIONS

A. Drawings are diagrammatic in character and do not necessarily indicate every required conduit, box, fitting, etc.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or must be made from field measurement, take the necessary measurements and prepare the drawings.

D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

E. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom, and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

F. Before any work is begun, determine that equipment will properly fit the space and that conduit can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.

G. Verify all dimensions by field measurements.

H. Arrange for chases, slots, and openings in other building components to accommodate electrical installations.

I. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring an access path for positioning prior to closing-in the building or space.

J. Where mounting heights are not detailed or dimensioned, install electrical conduits, boxes, and overhead equipment to provide the maximum headroom possible. In general, keep installations tight to structure.

K. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components as much as practical and connect equipment for ease of disconnecting and removal with minimum of interference with other installations.

L. Make allowance for expansion and contraction for all building electrical components and conduit systems that are subject to such.

M. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset and coordinate any systems as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

N. In general, all conduit systems shall be routed as high as possible. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

P. Coordinate the installation of electrical materials and equipment above and below ceilings with suspension system, luminaires, and other building components. Ductwork and piping shall not be installed above electrical panelboards, switchboards, motor control centers, and transformers.

Q. Coordinate the installation of electrical materials in casework, millwork, and furniture systems. For systems that are furnished with raceways, boxes, devices, cabling, and/or conductors, ensure that all NEC requirements are met as well as requirements in other applicable sections of these specifications. Physical separation shall be provided between different branches of power and between power and low voltage cabling.

1.4 COORDINATION

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, hangers, control devices, lighting, low voltage equipment, cable tray, conduit, transformers, disconnects, etc., necessary to overcome congested conditions at no increase in contract sum. The Contractors base bid shall include all time and manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 23 and Division 26 Contractors and shall furnish the same information involving control devices to the appropriate Contractor.
2. Automatic Doors and controls and other building access equipment shall have cut sheets reviewed and shall furnish the same information to the appropriate Contractor.

C. Coordination Drawings:

1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.
2. Prepare and submit a set of coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale of 1/4"=1'-0" or larger. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment. Indicate movement and positioning of large equipment into the building during construction.
3. Coordination drawings are informational submittals. Submit coordination drawings to Engineer for information only to document proper coordination of all portions of work and that coordination issues have been identified and resolved prior to submitting to the Engineer and prior to commencing construction in each affected area. The review of the coordination drawings by the Engineer does not constitute a relief of responsibility of the Contractor or a change to the contract documents. The Contractor shall have sole responsibility in developing a fully coordinated and integrated ceiling cavity.
4. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the Work.
5. Clearly indicate solutions to space problems. Identification of space problems without solutions is not acceptable. Only areas clearly identified will be reviewed.
6. Prepare coordination drawings and other Shop Drawings at a suitable scale, showing the required dimension. In addition to the mentioned areas and systems above, also submit specific equipment installations, including, but not limited to the following:

    a. Panelboards
    b. Equipment connections
    c. Control panels
    d. Circuit and motor disconnects

7. CAD Drawings: Electronic AutoCAD drawings are available for purchase by the Contractor from the Engineer. Contact Engineer for further information in acquiring CAD drawings. The Engineers Construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.
8. Wiring Diagrams: Provide wiring diagrams indicating field installed electrical power, control wiring, cabling layouts, overcurrent protective devices, equipment, and equipment connections.

D. Existing Conditions:

1. Contractor shall carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing Coordination drawings.
2. Contractor shall be responsible for showing all existing conditions on the coordination drawings.
3. Provide proper coordination of electrical work with existing conditions.
4. Contractor shall report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 coordination with other divisions

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains.
4. Plumbing vent piping.
5. Low pressure ductwork and air devices.
6. Electrical and communication conduits, raceways, and cable tray.
7. Domestic hot and cold water.
8. Hydronic piping.
9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
10. DDC control wiring and other low voltage systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings, and layouts so that openings, inserts, and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided, including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

F. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

1.6 design work required by contractor

A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Temporary Facilities.
2. Final coordinated distribution systems within the ceiling cavity.
3. Any system not fully detailed.
4. Fire alarm shop drawings.
5. Equipment supports, hangers, anchors, and seismic systems not fully detailed nor specified in these documents or catalogued by the manufacturer.
6. Seismic restraint systems.

1.7 PROJECT CONDITIONS

A. The contractor shall be required to attend a pre-bid walk-thru if required and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

B. Field verifies all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all work against theft, injury, or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

F. The Contractor shall coordinate and cooperate with Owner at all times for all new to existing connections.

G. Provide temporary electrical connections where required to maintain existing areas operable.

H. Coordinate all services shutdown with the Owner; provide temporary services. Coordinate any required disruptions with Owner, at a minimum one week in advance.

I. Minimize disruptions to operation of electrical systems in occupied areas.

1.8 SAFETY

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES

A. Refer to Division 1.

B. Execute and inspect all work in accordance with Underwriters Laboratories (UL), and all local and state codes, rules, and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the more stringent requirement shall be followed. Follow application sections and requirements and testing procedures of NFPA, IEEE, NEMA, CBM, ANSI, NECA, ICEA, NETA, and IETA.

C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

D. Energy Codes: All equipment and installations shall conform to Federal, State, and local Energy Conservation Standards.

E. The handling, removal and disposal of regulated liquids or other materials shall be in accordance with U.S. EPA, state, and local regulations.

F. The handling, removal and disposal of lead-based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.

G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

H. All material used on this project shall be UL listed and labeled and be acceptable to the authority having jurisdiction as suitable for the use intended.

1.11 PERMITS AND FEES

A. Refer to Division 1.

B. Contractor shall pay all fees required for connection to municipal and public utility facilities.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

B. All electrical and fire alarm systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic restraints shall be the responsibility of the contractor.

1.13 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc. Responsibility for providing temporary electricity, heat and other facilities shall be as identified in these specifications, as shown on the drawings and as specified in Division 1.

B. Building distribution equipment and devices (existing or new) shall not be used without written permission of the Owner. If used for temporary power, the equipment shall be properly maintained and

any damage resulting from use shall be repaired by the Contractor. The guarantee period for new equipment shall not begin until the equipment is turned over to the Owner.

C. If AC power systems or their backup systems serving telecommunications, computer equipment, or their associated HVAC equipment and controls are taken out of service, for any reason, the Contractor shall be responsible for providing temporary systems during the period when the AC power systems or their backup systems are out of service. The Contractor shall be responsible for providing temporary power to all loads being interrupted.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and Division 1.

B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.

1. Substitutions shall only be allowed upon the written approval of the Architect/Engineer
2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.

D. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:

1. Confirming the proposed equipment will fit in the space available, including the equipment’s clearance requirements.
2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
3. Inclusion in the bid of any applicable costs for changes in prime bidder’s and their sub bidders’ work required to accommodate the utilization of the comparable product.
4. The contractor shall bear all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.15 SUBMITTALS

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other, i.e., submit coordination and short circuit study prior to or together with gear, overcurrent protection devices, ATS, etc.

3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Subcontractor’s names, addresses, and contact information, etc. Each Specification Section shall be submitted individually, and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately, and returned by the same means received.
6. An index shall be provided which includes:

    a. Product
    b. Plan Code (if applicable)
    c. Specification Section
    d. Manufacturer and Model Number

7.
8. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed first in the specifications or on the drawings are the basis of design and are provided for the establishment of size, capacity, grade, and quality. If the contractor proposes alternates or substitutions in lieu of the first names, the cost of any changes in construction required by their use shall be borne by this Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards

D. Contractor Review: Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed unless written prior approval is obtained by the Contractor.

E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive product data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the ELECTRICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 26 Section.

F. The Design Professional’s review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

    1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes

2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with these criteria.

I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

J. If more than two submittals (either for product data, shop drawings, record drawings, test reports, or O&Ms) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."

L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

M. Submit letters certifying compliance with ANSI standards for medium or high voltage gear. These letters shall be signed by a corporate officer and shall list applicable standards. Letters signed by local representatives will not be acceptable.

N. Submit proposed changes to electrical room or other equipment room layouts when revised from contract documents prior to installation.

O. Mark submittals with designations as shown on the drawings and identify as required by specification sections. Identification shall contain the information as required in details and each label shall be submitted in list form with disconnects, panelboards, switchboards, overcurrent protection devices and utilization equipment.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

A. Product Listing:

1. Prepare listing of major electrical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect

    a. Provide all information requested.
    b. Submit this listing as a part of the submittal requirement; see Paragraph 1.15 "PRODUCT OPTIONS AND SUBSTITUTIONS."

2. When two or more items of same material or equipment are required (lighting, wiring devices, switchgear, panelboards, protective devices, etc.) they shall be of the same manufacturer.

Product manufacturer uniformity does not apply to raw materials, bulk materials steel bar stock, welding rods, solder, fasteners, except as otherwise indicated.

a. Provide products which are compatible within systems and other connected items.

3. For conduit, wire and fittings, the Contractor shall select a prime and alternate manufacturer from the list of acceptable manufacturers provided in the appropriate sections of this Division. The prime and alternate manufacturers shall be identified in the product listing. The contractor shall make every effort to use the prime manufacturer for the entire project. If products from this manufacturer are unavailable, the Contractor shall use the listed alternate with the following provisions.

a. Wire: All wire placed in a single conduit or installed in multiple conduits making up parallel feeders shall be of the same manufacturer.
b. Conduit and Fittings: All conduits and fittings installed exposed within the same room or immediate area shall be of the same manufacturer.

B. Schedule of Values

1. Provide Preliminary Schedule of Values to Engineer with product data submittal within four (4) weeks from award of contract to successful bidder. Provide according to the following descriptions:

a. General Construction (total)
b. Demolition
c. Lighting - Interior
d. Lighting Controls
e. Basic Materials/Devices/Equipment Connections (Mechanical)
f. Fire Alarm (Material/Installation)
g. Security

2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

a. Sizes.
b. Weights.
c. Speeds.
d. Capacities.
e. Conduit and electrical connection sizes and locations.
f. Statements of compliance with the required standards and regulations.
g. Performance data.
h. Manufacturer's specifications.
i. Housing and proposed finishes.
j. NEMA or other ratings that apply.

5. Checklist: Where identified in ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit a detailed checklist which acknowledges compliance or a reason for non-compliance to each of the specification requirements. Arrange the checklist according to the headings of each item identified in each specification (i.e. Shop Drawings, Wiring Diagrams, Product requirements, individual line items, etc.) Mark items as "N/A" where the item is not applicable.

D. Shop Drawings:

1. Shop Drawings are defined as electrical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Electrical Shop Drawings, except diagrams, to accurate scale, min 1/8”=1'-0", Electrical rooms shall be 1/4”=1’-0” unless otherwise noted.
3. Shop drawings shall include:

    a. Proposed equipment installations.
    b. Electrical characteristics and connection requirements.
    c. Clearance dimensions at critical locations.
    d. Dimensions of spaces required for operation and maintenance.
    e. Interfaces with other work, including structural support.
    f. Elevations in areas with multiple pieces of equipment on common walls or to clarify incoming/exiting methods/clearances, etc.
    g. Wall and floor penetrations.
    h. Wiring diagrams showing all components, internal connecting wiring, and contractor connection requirements including terminal blocks/lugs, wire sizes, etc.

E. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

F. Equipment Settings Report: Where identified in the ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit Equipment Settings Report for each device indicating final configurations and settings.

1. Provide report of settings, parameters, programing inputs and parameters, etc., installed at each piece of electrical equipment that allows adjustments to be made in the field and those set at the factory. The report shall be arranged by specification section and each piece of equipment broken out individually or by listing of equipment if the same settings are installed in multiple pieces of equipment.
2. In addition to the requirements above, include within this report any individual ground fault system settings; zone interlock operational settings; Arc Flash reduction schemes and levels; transfer switch settings including time delays and upstream protection device settings with copies of listed OCPD’s for each ATS; settings of monitoring equipment including trip levels and alarm levels; Generator settings and parameters; UPS settings and parameters; relay settings; transformer tap settings; phase rotation documentation; lighting control settings with associated timer settings; electrical interlock and/or kirk key system descriptions; posted operational signage; and any other pertinent information.
3. Report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

G. Software Licenses: Provide documentation of ownership under the owner's corporate name (coordinate with owner's representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

1.17 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1, Sections on Transportation and Handling and Storage and Protection.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage and weather.

E. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.18 DEMOLITION/REMODEL WORK

A. Refer to Division 1 Section on Summary of work for requirements on working in Owner-occupied areas of the existing building and Division 2 section on selective demolition. The following paragraphs supplement the requirements of other Divisions.

B. During the demolition phase of this contract, it is the responsibility of this Contractor to carefully remove existing equipment, conduits, boxes, and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage, and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.

C. The project involves renovation and remodel of the existing building. On the drawings, work may be denoted by showing items as bold or light line weight and certain renovation symbols are used. These indications and symbols are amplified as follows:

1. **Bold Print** (when used): Work included in this contract is denoted in bold print or darker line weight.
2. Light Print (when used): Work shown lightly indicates existing conditions to remain.

D. Existing equipment that is removed and not scheduled to be reused shall remain the property of the Owner and be delivered for disposition unless specifically indicated otherwise and shall be stored in a location designated by the Owner. Items which are removed and not wanted by the Owner shall become the property of the Contractor and shall be removed from the site.

E. Existing equipment that is removed and is to be reused shall be cleaned, serviced and operable before being reinstalled.

F. Revise panelboard schedules to reflect removal or relocation of equipment. Circuit integrity of equipment in adjacent areas shall be left intact.

G. Where remodeling interferes with existing circuits and equipment which are not to be removed, such circuits and equipment shall be reworked and relocated as required to complete the project.

H. The Contractor shall remove all distribution equipment, conductors, etc., which are indicated to be removed or which must be removed to accommodate demolition. Equipment to be removed may require reworking conduit and wiring to maintain service to other equipment.

I. Where remodeling interferes with circuits serving areas outside of the project or phase limits or which are remodeled in later phases of the project, circuits shall be reworked, or temporary circuits provided as required.

J. Existing equipment and circuiting shown are based on field surveys and/or Owner furnished drawings. The Contractor shall verify conditions as they exist with necessary adjustments being made to the drawing information.

K. Coordinate the routing of all conduits with the existing mechanical and plumbing systems to avoid conflicts with ducts, pipes, etc. Where existing electrical boxes, conduit, or equipment interfere with installation of new ducts, plumbing, walls, soffits, luminaires, outlets, etc., the Contractor shall resolve the conflict with the appropriate trade.

L. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated on the drawings or allowed under the appropriate section of the specifications.

M. Electrical Outages: Electrical outages must be held to a minimum. The Contractor shall submit a Method of Procedure (MOP) for each outage to the Owner, detailing the reasons for the outage, areas affected, sequence of procedures to accomplish work, estimated maximum length of time along with the date and time of day outage will occur. The Contractor shall meet with the Owner to set a schedule and date for the outage based on the MOP. Due to the critical implications of power outages, the Owner may direct the Contractor as to the time of day or night and date an outage may take place.

1. The Contractor will be responsible for providing temporary power required for the duration of the outages. The required outages to connect and disconnect the temporary power will require a MOP as described above.
2. Log each approved and implemented MOP and submit with O&M Manuals.

N. PCB Ballasts: PCB type ballasts may be present in existing luminaires. If PCB ballasts are discovered by the Contractor, report such occurrence to the Owner immediately. The Contractor shall remove and dispose of PCB type ballasts at an E.P.A. (Environmental Protection Agency) approved site in the prescribed manner acceptable to the EPA. The Contractor shall pay all fees associated with this work.

O. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken. Hazardous material removed is not a part of the work to be done under this Division.

P. Lamp Disposal: Contractor is responsible for sending removed lamps to be recycled. The Contractor shall ensure the recycling agency meets RCRA and CERCLA regulations. Provide certificate of compliance in O&M Manuals.

Q. On-Site Metering: When called for in the specifications or on the drawings, the Contractor shall meter the points indicated for a period of 30 days prior to submitting for permit to verify existing load. Meter shall record voltage; amperage; KVA; and Power Factor for each phase and sum of the phases. The

meter shall continually average the power demand over maximum 15-minute intervals as required by NEC 220.87. Compile a metering summary report and deliver results to engineer after 7 days and after 30 days. Verify existing loads at and downstream of the metering location and provide list to engineer of what loads are not on during the 30-day metering and the reason why. Organize list by equipment name. If any loads have been removed or permanently abandoned, turn circuit breaker off and relabel as SPARE.

1.19 CUTTING AND PATCHING

A. Cutting and patching of electrical equipment, components, and materials may be required for removal and legal disposal of selected materials, components, and equipment. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

B. Refer to Division 1 for cutting and patching requirements.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or nonconforming installations.

F. Perform cutting, fitting, and patching of electrical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.

G. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of conductors, conduit, luminaires, boxes, devices and other electrical items made obsolete by the new work.

H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

J. Locate, identify, and protect electrical services passing through remodel or demolition area and serving other areas required to be maintained operational.

K. When coring is required or identified, an x-ray of the area is to be taken prior to the performance of the work operation. X-ray work requires an MOP and protection.

1.20 ROUGH IN

A. Verify final locations for rough ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough in requirements.

C. Work through all coordination before rough in begins.

1.21 ACCESSIBILITY

A. Install equipment and materials to provide required code clearances and access for servicing and maintenance. Coordinate the final location with piping, ducts, and equipment of other trades to insure proper access for all trades. Coordinate locations of concealed equipment, disconnects, and boxes with access panels and doors. Allow ample space for removal of parts, fuses, lamps, etc. that require replacement or servicing.

B. Extend all conduits so that junction and pull boxes are in accessible locations.

C. Provide access panel or doors where equipment or boxes are concealed behind finished surfaces.

D. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and requirements.

E. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

F. Furnish doors to trades performing work in which they are to be built, in ample time for building in as the work progresses. Whenever possible, group equipment to permit use of minimum number of access doors within a given space.

G. Factory manufactured doors shall be compatible with the finish in which they are to be installed.

H. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.

1.22 TESTING

A. Submit test reports as outlined in Division 1 Sections on Quality Control Services and each Division 26 Section.

B. Testing as required by these specifications shall pertain to all equipment, wiring, devices, etc. installed under this contract and being reused.

C. General Scope:

1. Perform all tests and operational checks to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
2. The tests and operational checks shall determine the suitability for energization.

3. Schedule tests and give a minimum of two weeks advance notice to the Architect/Engineer. Reschedule testing for Owner convenience if required.

D. Test Report: Submit the completed report to the Architect/Engineer no later than fifteen (15) days after completion of test unless directed otherwise. The test report shall be bound, and its contents certified. A final compilation of all Test Reports shall be submitted with the Testing and Equipment Settings Report (Refer to Operation and Maintenance Data paragraphs).

E. Each test report shall include the following:

1. Project information including building name, address, date, and other pertinent information.
2. List of equipment tested.
3. Description of test.
4. List of test equipment used and calibration date.
5. Baseline, acceptable, or published target value for test with code or standard reference indicating where value was derived.
6. Test results that summarize all measured values with baseline values.
7. Conclusions and recommendations.
8. Appendix, including appropriate test forms that show all measured values.

F. Failure to Meet Test:

1. Any system material or workmanship which is found defective based on performance tests shall be reported directly to the Architect/Engineer.
2. All failed tests shall be sent immediately by email to Architect/Engineer with proposed corrective action and proposed re-test date and time.
3. Contractor shall replace the defective material or equipment as necessary, and have test repeated until test proves satisfactory without additional cost to the Owner.

G. The testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:

1. Field Instruments: 6 months
2. Laboratory Instruments: 12 months
3. Leased specialty equipment: 12 months. (Where accuracy is guaranteed by lessor
4. Dated calibration labels shall be visible on all test equipment.

1.23 NAMEPLATE DATA

A. Provide equipment with permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Install equipment so that nameplate is readily visible.

B. Phase Rotation

1. Existing Building: Match existing phase rotation.

1.24 METHODS OF PROCEDURE (MOP)

A. Definition: Method of Procedure (MOP) is a written plan which describes the activities and procedures to safeguard the building's occupants and contents and to interface with the building's management, operations, and security. Building occupants shall be defined as employees, patients, and visitors.

B. Requirements:

1. An MOP is required when a construction activity affects the safety of the occupants, equipment or valuable contents, or any supporting system; or essentially affects the building's management, operations, or security.
2. An MOP is required for any shutdown or interruption of any system which affects the building occupants, including, but not limited to, infrastructure, life safety, electrical, and building management systems.
3. An MOP is required when requested or deemed necessary by the Owner or Engineer.

C. Development:

1. The Prime Contractor shall develop, submit, track, and process the MOP. Any assistance required by the Subcontractors shall be provided. All MOPs shall be reviewed by the Prime Contractor prior to submitting the MOP to the Engineer.
2. All MOPs Shall Be Typed.
3. Contractor shall develop the MOP in a timely fashion prior to review and approval by all required parties.
4. Contractor shall develop the MOP with input from the subcontractor, where necessary.

D. Form: Each MOP shall be a written document in narrative, descriptive or outline form supplemented with drawings, diagrams and schedules as necessary.

E. Review and Approval: Contractor shall submit each MOP to the Engineer for review and approval. All MOPs require Owner's approval.

F. Implementation: Contractor shall implement the MOP when approved by the Engineer and Owner in writing. No construction activity which requires a MOP shall proceed until the MOP is approved.

G. Compliance: Contractor shall comply with the approved MOP. The Owner and Engineer reserve the right to stop the work for non-compliance with the MOP. Any cost or time delay resulting from the work stoppage shall be borne by the Contractor.

H. Posting: Work shall not proceed on any facet of the work involving any MOP if an approved and signed MOP is not posted in the work area.

1.25 CLEANING

A. Refer to the Division 1 Section on project closeout or final cleaning for general requirements for final cleaning.

B. Clean all luminaires, lamps and lenses per manufacturer’s recommendations prior to final acceptance. Replace all inoperative lamps.

1.26 RECORD DOCUMENTS

A. Refer to the Division 1 Section on Project Closeout or Project Record Documents for requirements. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; concealed control system devices, and any other relevant deviations from the Contract Documents.

D. Mark shop drawings to indicate approved substitutions; Addenda; Change Orders; actual equipment and materials used.

E. Schedules:

1. Mark luminaire schedule on drawings to indicate manufacturer and complete catalog numbers of installed equipment.
2. Mark schedules including panelboard, switchboard, motor control center, mechanical, kitchen and similar equipment schedules on drawings to indicate installed equipment and materials used, and any deviations or revisions to electrical load data and calculations.

F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme.

1. Red shall indicate new items, deviations, and routing.
2. Green shall indicate items removed or deleted.
3. Blue shall be used for relevant notes and descriptions.

G. At the completion of the project, obtain from the Architect a complete set of the Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit marked up and completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

I. One full size set of record drawing one-line diagrams shall be posted in the electrical room.

1.27 OPERATION AND MAINTENANCE DATA

A. Refer to the Division 1 Section on project closeout or operation and maintenance data for procedures and requirements for preparation and submittal of maintenance manuals.

B. No later than four (4) weeks prior to the completion of the project provide complete set of operating and maintenance manuals, or as specified in Sections of Division 1 (whichever is more stringent). Operation and Maintenance Data shall be submitted in electronic format.

C. Operation and Maintenance Data: Submit operation and maintenance data in maintenance manual in accordance with requirements of applicable Division 26 Sections and Division 1. Provide Operating and Maintenance Instructions in electronic format covering all equipment furnished. Manuals shall include all information required below, as indicated in each Division 26 Section, and the following for each piece of equipment:

1. The job name and address, contractor's name, address, and phone number, and each subcontractor's name, address, and phone number shall be identified at the front of the electronic submittal.
2. Name, address, and telephone number to be contacted of the local authorized service organization/company and individual to be contacted for service and maintenance for each item of equipment.
3. Submit operation and maintenance data, schedule of recommended service and parts lists for all materials and products specified and intended for installation. Include description of function, normal operating characteristics and limitations, fuse curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
4. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
5. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
6. Servicing instructions and lubrication charts and schedules.
7. Manufacturer's service manuals for all electrical equipment provided under this contract.
8. Complete equipment and protection wiring diagrams. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
9. Equipment identification numbers and adjustment clearly indicated for each piece of equipment.
10. Electrical System and Equipment Warranties.
11. Provide manuals tabbed and divided into major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
12. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.
13. Equipment Testing Report including all test reports and Equipment Settings Report indicating final configurations and settings.

D. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, settings reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.28 PROJECT CLOSEOUT LIST

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

1. The contractor shall be responsible for providing the items listed on the Electrical Submittal Checklist prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements (Checklist is located at the end of this section.)
2. Final payment will not be authorized until all items on the final punch list have been complete.

1.29 WARRANTIES

A. Refer to the Division 1 Section on Warranties and Bonds for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In no case shall

the warranty for the total electrical system be less than one year from date of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 26, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item. Information to include product or equipment description, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.30 CONSTRUCTION REQUIREMENTS

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1. Up-to-date record drawings.
2. Addenda
3. Change Orders
4. Submittals
5. Site observation reports with current status of all action items.
6. Test results; including recorded values, procedures, and other findings.
7. Outage information.

1.31 Electrical sUBMITTAL Checklist

A. Provide submittals including shop drawings, product data, product checklists, tests and reports, training, extra material, coordination drawings, record drawings, O&M manuals, device setting reports, and software licenses per the following schedule:

C – Product Checklist; Q – Qualifications, CD – Coordination Drawings, RD - Record Drawings, D – Device Setting Report; S – Software License, W – Special Project Warranty

SPEC Section	TITLE	Requirements									
		Report Data		Test	Factory Test	Report	Factory Rep Supervision at Site	Training Req'd at Site	Extra Material	O&M	Other
		Shop Drawings	Product Data								
26 05 00	Common Work Results For Electrical										
	Electrical Coordination Drawings	X									
	Existing Conditions Survey Drawings	X									
	Seismic Design Parameters per Local Authority	X	X			X				X	
	Temporary Facilities	X	X			X					
	Product Listing		X							X	C
	Preliminary Schedule Of Values					X					
	Final Schedule Of Values					X				X	
	Lamp disposal Certificates /PCB/Hazardous Material			X		X				X	
	Electrical On-Site Metering Reports			X		X				X	

C – Product Checklist; Q – Qualifications, CD – Coordination Drawings, RD - Record Drawings, D – Device Setting Report; S – Software License, W – Special Project Warranty

SPEC Section	TITLE	Requirements									
		Report Data		Test	Factory Test	Report	Factory Rep Supervision at Site	Training Req'd at Site	Extra Material	O&M	Other
		Shop Drawings	Product Data								
	Tests/Independent Testing	X	X	X	X	X	X	X		X	D
	Completed/Signed MOP's					X				X	
	Record Drawings including changes to existing Equip.	X								X	
	O&M Manuals	X	X	X	X	X			X	X	C,D,S
	Project Closeout List					X				X	
	Contractor/Equipment Warranties					X				X	
26 05 19	Low Voltage Electrical Power Conductors And Cables		X	X		X				X	
26 05 26	Grounding And Bonding For Electrical Systems	X	X	X		X				X	
26 05 29	Hangers And Supports For Electrical Systems	X	X							X	
26 05 33	Raceway And Boxes For Electrical Systems	X	X								CD, RD
	Conduit		X								CD, RD
	Wireways	X	X							X	CD, RD
26 05 34	Cabinets, Boxes & Fittings	X	X								CD, RD
26 05 53	Identification For Electrical Systems	X	X							X	
26 05 83	Wiring Connections	X	X	X							D
26 09 23	Lighting Control Devices	X	X	X		X	X	X	X	X	C CD, RD,,D,S
26 27 26	Wiring Devices		X	X		X				X	
26 28 00	Low Voltage Circuit Protective Devices	X	X	X		X		X	X	X	C, D.S
26 50 00	Lighting	X	X	X		X			X	X	
	Ballasts, LED's, Drivers	X	X	X		X				X	W

END SECTION 260500

SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.2 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.

C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

1.3 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's data on electrical wires, cables, and connectors.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable properly packaged in factory fabricated type containers or wound on NEMA-specified type wire and cable reels.

B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handle wire and cable carefully to avoid abrading, puncturing, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of wire, cable, and connector):

1. Wire and Cable:

    a. Belden
    b. Cerrowire
    c. Encore Wire
    d. General Cable Corporation.
    e. Southwire Company
    f. Okonite
    g. Superior Essex

2. Connectors:

    a. Emerson
    b. AMP, Inc.
    c. Burndy Corporation.
    d. Ideal Industries, Inc.
    e. 3M Company
    f. ABB

2.2 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed.

B. Conductors: Provide solid or stranded conductors and approved connectors for power, control, and lighting circuits 10 AWG and smaller. Provide stranded conductors for 8 AWG and larger.

C. Conductor Material: Provide copper for all wires and cables.

1. Metal Clad Cable - Type MC: Sizes 12 AWG and 10 AWG, copper conductors with 600-volt thermoplastic insulation rated 90 degrees C, galvanized steel or aluminum interlocked metal type covering. Fitting shall have double grip saddle and locking nut.
2. Portable Cord:

    a. Type SO: Sizes 12 AWG through 2 AWG, copper conductors with 600-volt thermoset insulation 0.1 resistant insulation.
    b. Type G-GC: Sizes 1 AWG through 500 KCMIL, copper conductors with 600/2000-volt, 90 degrees C, ethylene-propylene insulation.

3. Cables: Provide the following types of cables in NEC approved locations and applications where permitted by the contract documents. Cables shall be U.L. listed and approved by the local building authority. All cables shall contain a green insulated equipment ground conductor of the same size as the neutral conductor.

2.3 CONNECTORS

A. Description: Provide UL-type, factory fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.

B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections when installed on bus bars. (Including phase, neutral and grounding conductors).

C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

A. Building Wire: Install all building wire in raceway regardless of location.

B. Metal Clad Cable:

1. Maximum of 6 feet unsupported length for connecting luminaires in accessible ceilings to the local junction box.
2. Maximum of 6 feet unsupported length for connecting luminaires in non-accessible ceilings to the local junction box.
3. In stud walls and casework for horizontal branch circuit runs between devices.
4. For vertical branch circuit drops from a local junction box in each room above an accessible ceiling to the direct or single device in a stud wall, casework, under counter lighting.
5. May not be used for branch circuit home runs, feeders, motor feeder circuits or in the following locations:

    a. Hazardous locations
    b. Emergency Systems

6. Branch circuit conductors shall match color coding schedule within this specification section.

C. Portable Cord: Use for flexible pendant leads to luminaires, outlets, and equipment where indicated and in compliance with codes.

3.2 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.

D. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.

E. Keep conductor splices to a minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control, or fire alarm wiring. Connect un-spliced wire to numbered terminal strips at each end.

F. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

G. Use splice and tap connectors which are compatible with conductor material.

H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A for copper and 486B for aluminum.

I. Support cables above accessible ceilings. Independent from the ceiling suspension system to support cables from structure, do not rest on ceiling tiles.

J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.

K. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type is not acceptable.

L. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.

M. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

N. Thoroughly tape the ends of spare conductors in boxes and cabinets.

O. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.

P. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.

Q. Branch circuits whose length from panel to first outlet exceeds 100 feet for 120-volt circuits or 175 feet for 277-volt circuit shall be 10 AWG or larger, as required to comply with the National Electrical Code.

R. Parallel conductors shall be cut to the same length.

S. All splices in control panels, terminal junction boxes, low voltage control circuits, fire alarm, etc., conductors shall be on numbered terminal strip.

T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor, or other air plenum spaces.

U. Provide wire training, lacing, labeling, and terminal blocks as required in panelboards and all control cabinets including, but not limited to, lighting, transfer switch, fire alarm, and security cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.

1. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.

V. Color coding of switch legs, travelers, etc. shall be different and distinct from phase and neutral conductors. Where systems utilize two (2) different voltages, the color coding of switch legs, travelers, etc. shall be different and distinct for each voltage system.

3.3 FIELD QUALITY CONTROL

A. Test installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders regardless of size and on all branch circuits with No. 4 AWG and larger conductors. The megger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be meagered after installation, and prior to termination. Submit test report.

B. Prior to energization, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.4 COLOR CODING SCHEDULE

A. Color code secondary service, feeder, and branch circuit conductors as follows:

120/208 Volts	Phase	277/480 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

B. Conductors shall be solid color for entire length.

C. If solid color conductor insulation is not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:

1. Conductors 6 AWG and smaller shall be solid color for the entire length.
2. Conductors 4 AWG and larger shall have either solid color insulation as specified above for the entire length or be black with color coding at each termination and in each box or enclosure. For 6 inches use half-lapped 3/4-inch plastic tape in the above specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.2 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for ground rods, connectors and connection materials, and grounding fittings.

C. Wiring Diagrams: Submit wiring diagrams for electrical grounding and bonding work which indicates layout of ground rings, location of system grounding electrode connection, routing of grounding electrode conductors, also include diagrams for circuits and equipment grounding connections.

1.3 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Burndy Corporation
2. Cadweld Div.; Erico Products Inc.
3. Ideal Industries
4. OZ Gedney Div.
5. Thermoweld
6. ABB Installation Products

2.2 GROUNDING AND BONDING PRODUCTS

A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS

A. General: Comply with Division 26 Section on Wires and Cables. Conform to NEC, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors: Conform to the following:

1. Solid Conductors: ASTM B-3
2. Assembly of Stranded Conductors: ASTM B-8
3. Tinned Conductors: ASTM B-33

2.4 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 CONNECTOR PRODUCTS

A. General: Listed and labeled as grounding connectors for the materials used.

B. Pressure Connectors: High-conductivity-plated units.

C. Bolted Clamps: Heavy-duty units listed for the application.

D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

2.6 GROUNDING ELECTRODES:

A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.

1. Size: 3/4-inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATION

A. Equipment Grounding Conductor: Comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:

a. Feeders and branch circuits.
b. Provide individual grounding and neutral conductors for each isolated ground receptacle. When individual or groups of isolated ground receptacles are on dedicated circuits, individual ground and neutral conductors for each circuit is acceptable.

2. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways unless they are designated for telephone or data cables.
3. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120-V and above including air cleaners and heaters. Bond the conductor to each such unit.
4. Water Heater, Heat Tracing, and Anti-Frost Heater Circuits: Install separate insulated equipment ground conductor to each electric water heater, heat tracing, and surface anti-frost heating cable. Bond this conductor to heater units, piping, and connected equipment and components.

B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.

C. Signal and Communications: For telephone, alarm, and communication systems, provide a #6 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.

D. All systems shall be grounded in accordance with the NEC.

3.2 INSTALLATION

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

B. Electrical Room Ground Bus: Size, location, and arrangement as indicated. Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.

C. Ground Rods: Locate a minimum of two rod lengths from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 24 inches below grade. Connect bare cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

D. Braided Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.

E. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

F. Labeling: Provide a phenolic tag for all grounding electrode conductors as described in section on Electrical Identification.

G. Where grounding conductors, grounding electrode conductors, or bonding conductors are non-exposed, identify each with a 6-inch band of green tape at each end and at 10-foot intervals. When run in conduits, provide color banding on conduit per section on Electrical Identification.

3.3 CONNECTIONS

A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors. Terminate each conductor on an individual ground lug terminal.

D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

E. Compression Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

F. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

B. Ground Resistance Test:

1. Grounding electrode resistance testing shall be accomplished with a ground resistance direct-reading single test meter utilizing the fall-of-potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the ground electrode to be tested and the two reference electrodes in a straight line spaced fifty (50) feet apart. Drive the two reference electrodes five (5) feet deep.

C. Correct Deficiencies, Retest and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace conductors, units and rods as required to bring system into compliance.
2. Prepare a written report and show temperature, humidity, and condition of soil at time of tests. Report shall be certified by testing agency that identifies components checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

3.5 CLEANING AND ADJUSTING

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Restore vegetation and disturbed paving to original condition.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for each type of product specified.

1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Shop drawings indicating details of fabricated products and materials.

D. Engineered Design consisting of details and engineering analysis for supports for the following items:

1. Trapeze hangers for multiple conduit runs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Slotted Metal Angle and U-Channel Systems:

a. Atkore
b. Eaton

2. Conduit Sealing Bushings:

a. Eaton
b. Hubbell
c. ABB

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Powder-Driven Threaded Studs: Heat treated steel, designed specifically for the intended service.

C. Conduit Sealing Bushings: Factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable iron casting with hot dip galvanized finish.

E. UChannel Systems: 12-gage steel channels, with 9/16-inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with Uchannel and are of the same manufacture.

F. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. One-Hole Conduit Straps: For supporting 1 inch and smaller rigid metal conduit; galvanized steel.
2. Two-Hole Conduit Straps: For supporting larger than 1 inch metal conduit, galvanized steel; 3/4-inch strap width; and 2-1/8 inch between center of screw holes.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop or field fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
2. EMT, IMC, or Rigid Conduit.

2.5 FIRE SEALS

A. Material: Fire stopping material shall be asbestos free, 100 percent intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.

B. Flame Spread: 25 or less, ASTM E84

C. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated "F" and "T" in accordance with ASTM E 814 or UL 1479. Rating periods shall conform to the following:
(F) 3 (T) 3 Time-rated floor or wall assemblies.

(F) 3 (T) 3 Openings between floor slabs and curtain wall.

D. Manufacturers: Subject to compliance with requirements, provide fire seals of the following:

1. 3M Company
2. STI
3. Tremco
4. Hilti

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Junction Box Supports: Comply with the NEC and the following requirement:

1. Use 1/4-inch all-thread rod from structure to support junction boxes.

D. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Use #9 ceiling wire to support individual conduits up to 3/4-inch with spring steel fasteners. Use of ceiling support wires is unacceptable.
5. Support parallel runs of horizontal raceways together on trapeze type hangers. Use 3/8-inch diameter or larger threaded steel rods for support.
6. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch diameter or larger threaded steel. Use spring steel fasteners that are specifically

designed for supporting single conduits or tubing. For hanger rods supporting 1-1/2-inch or larger conduits provide 3/8-inch minimum threaded steel rods with pipe hangers.

7. Space supports for raceways in accordance with NEC. When there are 4 or more 2-inch conduits in a trapeze, supports shall be spaced 5 feet O.C.
8. In all runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
9. Threaded rod supports to have bottoms cut off at a maximum length of 2-inches.
10. Attachment of electrical supports to piping, ductwork, mechanical equipment or conduit is not allowed.

E. Conductor or Cable Supports: Comply with the NEC and the following requirements:

1. Support individual conductors or cables by separate clamps with rubber or plastic grommet, fasten using a non-metallic bolt and nut, and secure clamps to strut supports anchored to structure (multiple clamps may be secured to a single strut support). Individual conductors or cables may be served utilizing a vinyl or fiberglass clamp which shall be anchored to the structure.
2. Space supports as follows:

    a. Horizontal conductors not more than 3 feet o.c.
    b. Vertical conductors not more than 5 feet o.c.

3. Install simultaneously with installation of conductors.
4. MC Cable shall be supported by UL listed clip or clamp. Cable tie support is not acceptable.

F. Miscellaneous Supports: Support miscellaneous electrical components separately and as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

G. In overhead spaces, support metal boxes directly from the building structure via 1/4-inch minimum all-thread or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24-inches from the box. Supporting metal boxes utilizing ceiling type wire is not acceptable.

H. Sleeves: Install in concrete slabs and walls and all other fire rated floors and walls for cable installations as required. Where sleeves through floors are installed, extend above finish floor. For sleeves through fire ratedwall or floor construction, apply ULlisted fire stopping sealant in gaps between sleeves and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 7 Section "Joint Sealers." See Architectural plans for location and extent of fire rated assemblies.

I. Conduit Seals: Install seals for conduit penetrations of exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

J. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts or self-drilling masonry anchors on concrete or solid masonry, cast in inserts on precast structures, spring tension clamps on steel. Drilling of structural steel members is prohibited. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws, where authorized by the Owner and structural engineer. Do not weld conduit, pipe straps, or items

other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Coordinate with the owner and structural engineer and obtain written prior approval of all work on concrete beams. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

K. Communication and Telephone Cable Supports: Use No. 9 ceiling wire to support individual or small bundles of cables run above accessible ceilings.

3.2 PERSONNEL PROTECTION

A. Where U-channel systems, angles, brackets or other standard structural metal shapes are readily accessible and exposed to personnel, provide plastic or rubber end caps.

B. Where threaded rod supports are readily accessible and exposed to personnel, provide plastic or rubber end caps.

3.3 FIRE STOPPING LOCATIONS

A. Preparation:

1. Coordination: Coordinate the work with other trades. Fire stopping materials at penetrations of insulated pipes and ducts can be applied after insulation is in place. If insulation is composed of combustible material, the thickness of fire stopping materials must be equivalent to that of the insulation. If the insulation is composed of non-combustible material, it may be considered as part of the penetrating item.
2. Surface Preparation: Surface Preparation to be in contact with fire stopping materials shall be free of dirt, grease, oil, loose material or other substances that may affect proper fitting or the required fire resistance.

B. Installation: Install fire-stopping materials in accordance with the manufacturer's instructions.

C. Cleaning: After completion of fire stopping work in any area, equipment shall be reviewed and walls, ceilings and all other surfaces shall be cleaned of deposits of firestop materials.

D. Inspection: The architect may select, and the Owner will pay an independent testing laboratory to examine fire stopped areas to ensure proper installation prior to concealing or enclosing the fire stopped areas.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND WIREWAY FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of raceway work is indicated by drawings and schedules. Provide complete conduit systems for all conductors unless otherwise specified.

B. Types of raceways specified in this section include the following:

1. Electrical metallic tubing (EMT).
2. Flexible metal conduit.
3. Liquid-tight flexible metal conduit.
4. Rigid metal conduit (RGC).
5. Wireways.
6. Rigid Aluminum Conduit.

1.2 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

1.3 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating the materials comply with requirements.

C. Shop Drawings: Submit dimensioned drawings of surface metal raceway systems showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, if any. Show connections to electrical power panels and feeders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the following:

1. Metallic Conduit:

a. Atkore
b. Wheatland
c. Western Tube & Conduit
d. Nucor Tubular

2. PVC Coated Conduit:

a. Atkore
b. Rob Roy
c. ABB

3. Non-Metallic Conduit:

a. Carlon
b. Can-Tex

4. Steel Fittings:

a. Hubbell
b. Emerson
c. Picoma
d. ABB

5. Conduit Bodies:

a. Hubbell
b. Appleton
c. Eaton

6. Wireway:

a. Schneider Electric Erickson Electric Equipment Co.
b. Hoffman Engineering Co.

2.2 METAL CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGC):

1. Conduit: Rigid steel, zinc-coated inside and outside, threaded ends.
2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

B. Intermediate Metal Conduit (IMC):

1. Conduit: Rigid intermediate grade galvanized inside and outside, threaded ends.
2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

C. PVC Externally Coated Rigid Steel Conduit:

1. Conduit: Rigid steel zinc-coated with external coating of PVC.
2. Fittings: Threaded galvanized steel with external PVC coating, bushings shall have nylon insulated throat.

D. Electrical Metallic Tubing (EMT):

1. Conduit: Galvanized steel tubing.
2. Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set screw for all other connections. Setscrew quick fit type for 2-1/2 inches and larger may be used. Connectors shall have insulated throat or threaded nylon bushing.

E. Rigid Aluminum Conduit:

1. Not allowed unless otherwise noted.

F. Flexible Metal Conduit:

1. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, approved for grounding.
2. Fittings: Zinc coated, malleable iron. Straight connector shall be one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two-piece body with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings shall be terminated with threaded bushings having nylon insulated throats.

G. Liquid-Tight Flexible Metal Conduit:

1. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, approved for grounding.
2. Fittings: Zinc coated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.

2.3 NON-METALLIC CONDUIT AND DUCTS

A. Rigid Non-Metallic Conduit (RNC):

1. Conduit: Schedule 40 or 80 polyvinyl chloride (PVC), 90°C for direct burial or concrete encasement.
2. Fittings: Mate and match conduit type and material. Cement as recommended by manufacturer.

B. PVC and ABS Plastic Utilities Duct:

1. Conduit: Type 2 (EB) for encased burial in concrete; Type II (DB) for direct burial.
2. Fittings: Mate and match conduit type and material. Cement as recommended by manufacturer.

2.4 CONDUIT BODIES

A. General: Types, shapes, and sizes, as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use malleable iron conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.

C. Nonmetallic Conduit: Use nonmetallic conduit bodies.

2.5 WIREWAYS

A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.

B. Lay-In Wireways: Construct lay-in wireways with hinged covers in accordance with UL 870 with components UL listed. Construct units to be capable of sealing cover in closed position with sealing wire.

1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature.
2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

C. Rain-tight Troughs: Construct in accordance with UL 870, with components UL listed.

1. Construction: 16-gauge galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14-gauge parts for 8" x 8" and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures. Do not use Gasketing that can rip or tear during installation or would compromise rain-tight capability of the trough. Do not use cover screws that will protrude into the trough area and damage wire insulation.
2. Finish: Provide 14-gauge and 16-gauge galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

2.6 CONDUIT SIZES

A. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus a parity sized equipment ground conductor and be subject to the following minimum sizes:

1. Rigid, Intermediate, and EMT Conduit: 3/4-inch for all runs except lighting switch legs, 277-volt lighting branch circuits, temperature control and fire alarm which may be 1/2-inch.
2. Flexible and Liquid-Tight Flexible Conduit: 1/2-inch for all runs.
3. MC Cable: 3/8-inch to under-counter luminaires, 1/2-inch for all other runs.
4. Underground or Concrete Encased Nonmetallic Conduit: 3/4-inch for all runs.
5. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining multiple home runs into a single conduit will not be permitted.

2.7 RACEWAY SEALING COMPOUND

A. Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 deg. F (1 deg. C), withstands temperature of 300 deg. F (149 deg. C) without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials and the common metals.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 CONDUIT SCHEDULE

A. Raceways in all other areas shall be electrical metallic tubing unless otherwise noted.

B. Raceways in locations subject to mechanical injury**:** Rigid steel galvanized conduit or intermediate metal conduit. Locations subject to mechanical injury include, but are not limited to, the following:

1. Exposed conduits outdoors and in parking garages up to 8 feet above finished grade.
2. Exposed conduits in dock areas and high/medium bay locations up to 8 feet above finished floor.
3. Exposed conduits in a Fire Pump Room.

C. Motor and equipment connections**:** PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors.

D. Use flexible metal conduit inside movable partition wireways, from junction boxes to devices and between devices in casework, from outlet boxes to recessed luminaires, and for "fishing" of existing walls.

E. Rework or extensions of existing conduit shall include the use of similar materials to the existing conduit type unless otherwise noted.

3.3 INSTALLATION OF CONDUITS

A. General: Install electrical raceways in accordance with manufacturer's written installation instruction, applicable requirements of NEC, and as follows:

1. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
2. Elevation of Raceway:

    a. Where horizontal raceway is installed near water and steam piping, route raceway above piping and as close to structure as possible and practical.
    b. Route raceway as close to structure as possible.

3. Complete installation of electrical raceways before starting installation of conductors within raceways.
4. Provide supports for raceways as specified elsewhere in Division 26.
5. Prevent foreign matter from entering raceways by using temporary closure protection.
6. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bend is not visible above the finished slab.

7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
8. Use raceway fittings that are types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints.
9. Run raceways parallel and perpendicular to building elements and other equipment with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
10. Raceways embedded in slabs: (Allowed only by written authorization of Structural Engineer/Architect): Install with a minimum of bends, in the shortest practical distance, in middle third of the slab thickness where practical, and leave at least 1 inch concrete cover. Tie raceways to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in the concrete. Run conduit larger than 1-inch trade size, parallel with or at right angles to the main reinforcement; where at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Where nonmetallic conduit is used, raceways must be converted to PVC coated rigid steel conduit before rising above floor.
11. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.
12. Install vertical feeder conduits in exterior walls, core walls, or chase spaces. Do not install in interior wall partition areas.
13. Run exposed and parallel raceways together. Make bends in parallel runs from the same center line so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases, provide field bends for parallel raceways.
14. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.
15. Tighten set screws of thread less fittings with suitable tool.
16. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. RGC and IMC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon insulated throats or threaded nylon bushings from 1/2-inch to 1-inch. 1-1/4-inch and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panelboards, pull boxes, transformers, motor control centers, VFD's, etc.
17. Conduit sleeves shall have bushings as described for terminations.
18. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
19. Provide nylon pull string with printed footage indicators having not less than 200 pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull string. Identify with tags at each end the origin and destination of each empty conduit and indicate same on all empty or spare conduits on the as-built drawings.
20. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

    a. Where conduits enter or leave hazardous locations.
    b. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.

c. Where conduits enter through a foundation wall or stub-up through a slab on grade floor.
d. Where required by the NEC.

21. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded plugs flush with floor.
22. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate equipment grounding conductor across flexible connections. Where PVC conduit/couplings have been approved for exterior use and are exposed to sunlight, provide UV rated PVC coatings or protect with 2 coats of water based latex paint that is chemically compatible with the PVC products. Color selection shall be by Architect.
23. PVC externally coated rigid steel conduit: Patch all nicks and scrapes in PVC coating after installing conduit.
24. Where conduits are to be installed through structural framing members, the Contractor shall provide sleeves. The Architect/Engineer's written approval must be obtained prior to cutting, notching, or drilling of structural framing members.
25. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.
26. Use of running threads for rigid or intermediate metallic conduit are not permitted. When threaded couplings cannot be used, provide 3-piece union or solid coupling.
27. Route conduit through roof openings for piping and ductwork where possible; otherwise, rout through jack with pitch pocket.
28. Conduit stub-ups from below grade or thru the slab shall be PVC coated or PVC taped rigid steel galvanized conduit and shall extend 6 inches above grade.
29. Wherever conduits enter a structure through a foundation or basement wall below grade, grout around the conduit with water-proof grout or install entrance seals. Seals shall be OZ Type WS or approved equivalent for new construction and OZ type CSM Series for existing structures.
30. Conduits shall not cross pipe shafts or ventilation duct openings. Where conduits must penetrate air-tight spaces or plenums, seal around the conduit with a mastic acceptable to the Architect/Engineer.
31. Install an insulated equipment grounding conductor in all conduits.
32. Where individual conduits penetrate existing fire-rated walls and floors, pack void around conduit with fire rated insulation and seal opening around conduit with UL listed foamed silicone elastomer compound. Where conduits penetrate exterior walls, new floors, or roof, provide pipe sleeve one size larger than conduit, pack void around conduit with fire rated insulation, and seal opening around conduit with UL listed foam silicone elastomer compound.
33. Where conduit sleeves penetrate fire rated floors or walls for installation of system cables, AC or MC cables, or modular wiring cables pack void around cables or empty sleeve with fire rated insulation and fill ends with fire-resistive compound. Seal opening around sleeve with UL listed foam silicone elastomer compound.
34. Use PVC-coated rigid steel or Fiberglass factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length. Use long sweep bends for wiring larger than 350 KCMIL.
35. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
36. No PVC conduit shall be run exposed or inside stud or masonry walls unless specifically called for on the drawings. Transition from PVC to metal conduit shall be made below grade.
37. Provide separate raceway systems for each of the following:

    a. Lighting
    b. Power Distribution
    c. Communications and Data

d. Emergency Systems
e. Fire Alarm
f. Temperature Control

38. Paint new exposed conduits to match existing exposed conduits where installed in areas with existing painted conduits or where otherwise indicated.
39. Provide rebar and tie downs for all conduits and conduit racks to be installed with concrete or slurry to prevent conduit “float”.
40. In open ceiling areas, other than equipment rooms, all wiring and cabling to be installed in conduit.

B. Install buried electrical line warnings per Division 26 section - “Electrical identification”.

C. Install labeling as required in Division 26 section - “Electrical Identification”.

3.4 INSTALLATION OF WIREWAYS

A. Wireways: Mechanically assemble metal enclosures and raceways to form continuous electrical conductor and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

1. Where practicable, avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. Field bends of raceway sections are not permitted.
4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
5. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., are not permitted for use with surface raceway installations.
6. Install an insulated grounding conductor in all wireways and surface raceways. Bond grounding conductor to all wireways and surface raceways.
7. Paint new exposed surface metal raceway to match adjacent surfaces where raceway is installed in finished areas such as lobbies, corridors, and normally occupied spaces.
8. Wireways are acceptable only where specifically indicated on the drawings. The proposed use of surface raceways and wireways shall be submitted for review by the Engineer prior to installation.
9. Common wireways are not acceptable for convergence of multiple circuits unless specifically indicated on the drawings. The proposed use of a common wireway shall be submitted for review by the Engineer prior to installation.
10. The proposed use of wireways above or below panelboards, switchboards, motor control centers, and other electrical equipment shall be submitted along with a layout drawing for review by the Engineer prior to installation.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION 260533

SECTION 260534 - CABINETS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this section include:

1. Outlet and device boxes
2. Pull and junction boxes
3. Cabinets
4. Hinged door enclosures

B. Conduit-body-type electrical enclosures and wiring fittings are specified in the Division 26 Section on Raceways.

1.2 DEFINITIONS

A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.

B. Device Box: An outlet box designed to house a receptacle device, or a wiring box designed to house a switch.

C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.

E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or switches for controlling electrical circuits.

1.3 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Submit product data for cabinets and enclosures with classification higher than NEMA 1.

C. Shop drawings for boxes, enclosures, and cabinets that are to be shop fabricated (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1.
2. Cabinets:

a. Hoffman Engineering Co.
b. Erickson Electrical Equipment Co.
c. Schneider Electric

2.2 CABINETS, BOXES, AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers including blank covers for unused boxes, knockout closures for unused openings and other accessories required for the intended use. Provide gaskets for units in damp or wet locations. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

2.3 MATERIALS AND FINISHES

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.

E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted Interior Finish: Where indicated, white baked enamel. Emergency system cabinets and boxes shall be red.

G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connecters.

2.4 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application. For multiple device installations, use multi-gang boxes. Sectional boxes are not permitted. Provide barrier for different voltage conductors in the same box.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be 4” square minimum with 2” depth minimum sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior/plaster rings and fixture studs.

C. Cast Aluminum Boxes: Copper free aluminum deep type, with threaded raceway entries/hubs, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices and closure plugs.

D. Malleable or Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.5 PULL AND JUNCTION BOXES

A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

C. Hot Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot dip galvanized after fabrication. Cover shall be gasketed.

D. Cast Aluminum Boxes: Molded of copper free aluminum, with gasketed cover and integral threaded conduit entrances and Neoprene gaskets.

E. Malleable or Cast-Iron Boxes: Molded of iron alloy with gasketed cover and integral threaded conduit entrances.

2.6 CABINETS

A. Comply with UL 50, "Electrical Cabinets and Boxes."

B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one-piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4-inch larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inches.

D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical and electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.7 STEEL ENCLOSURES WITH HINGED DOORS

A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."

B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.

C. Doors: Hinged directly to cabinet and removable, with approximately 3/4-inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation.

E. Enclosure: NEMA 1 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.8 CAST METAL ENCLOSURES WITH HINGED DOORS

A. Copper free aluminum with bolted, hinged doors. Where used at hazardous (classified) locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions. Coordinate box locations with Architectural elements including casework, backsplash, door swings, etc.

B. Cap with Knock out closures all unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items securely in accordance with Division 26 Section on Supporting Devices.

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated. Size boxes to accommodate wire pulling, splices, taps, equipment connections and code compliance.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS

A. Cabinets: Flush mounted, NEMA enclosure type 1 except as otherwise indicated.

B. Hinged Door Enclosures Indoor: NEMA type 1 enclosure except as indicated.

C. Hinged Door Enclosures Outdoors: NEMA Type 4. Install drip hood, factory tailored to individual units.

D. Hinged Door Enclosures in Corrosive Locations: NEMA type 4X nonmetallic enclosure.

E. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:

1. Interior Dry Locations: Sheet steel, NEMA Type 1.
2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
3. Wet Locations: NEMA Type 4 enclosures.
4. Corrosive Locations: NEMA Type 4X enclosures.

F. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.3 INSTALLATION OF OUTLET BOXES

A. Outlets at Windows and Doors: Locate close to window trim. For outlets indicated above doors center outlets above the door opening except as otherwise indicated.

B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.

C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.

D. Gasketed Boxes: At the following locations use malleable or cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.
2. Where surface mounted on unfinished walls, columns, or pilasters. (Cover gaskets may be omitted in dry locations).
3. Where exposed to moisture laden atmosphere.
4. High traffic areas (surface installations).
5. Where indicated.

E. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles vertically, except above counter receptacles to be mounted horizontally. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Provide far side box supports, for electrical switch boxes installed on metal studs and provide stud to stud support for electrical receptacle boxes installed on metal studs.

F. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1-1/2 inches deep, minimum.

G. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

H. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

I. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.

J. Back-to-back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.

3.4 INSTALLATION OF PULL AND JUNCTION BOXES

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

Size of Largest Conductors in Box	Maximum no. of Conductors in Box
No. 4/0 AWG	30
250 KCMIL	20
500 KCMIL	15
Over 500 KCMIL	10

B. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.

C. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling. Where possible, locate pull and junction boxes above accessible ceilings in finished areas.

D. Flush in grade outdoor boxes shall be adequately supported against settling or tipping. Where heavy traffic or poor soil compaction exists, cast box in concrete base which provides 6” of cover around and under the box.

E. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor.

C. Set cabinets in finished spaces flush with walls.

3.6 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.7 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 260534

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labeling for raceways, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

B. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 23.

1.2 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data for each type of product specified.

C. Submit schedule of identification nomenclature to be used for identification signs and labels for each type of equipment.

1.3 QUALITY ASSURANCE

A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ideal Industries, Inc.
2. Markal Corp.
3. Panduit Corp.
4. W.H. Brady, Co.
5. 3M Company

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Color Code Scheme 600V and below:

B.

Branch	Background Color	Letter Color	Label
Normal	Black	White	Source equipment designation, circuit number(s), and voltage
Standby	OSHA Orange	Black	
Fire Alarm	OSHA Red	White	“FIRE ALARM”
BMS/Temperature Control	Dark Blue	White	“TEMP. CONTROL”
Ground	Safety Green	White	"GROUND" and equipment designation
Data and Telephone	Light Blue	Black	“DATA” or “PHONE”
Network Fiber	White	Black	“NETWORK FIBER”
Security	White	Orange	“BUILDING ALARMS”
Paging and Sound	Grey	Black	“SOUND”

C. Provide colored Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width. Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Engraved, Plastic Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face for normal and white letters on red face for emergency, black letters on yellow face for UPS and punched for mechanical fasteners. Where required for ground connections, provide engraved legend in white letters on green face.

F. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless steel screws when screw ends do not protrude into working areas of equipment otherwise use number 10/32 stainless steel machine screws with nuts and flat and lock washers or rivets.

G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50 lb. minimum tensile strength, and suitable for a temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color coding.

H. Adhesive Marking Tape for Device Cover Plates: 3/8-inch Kroy tape or Brother labels with 3/16-inch minimum height letters. Tape shall have black letters on clear background for normal and red letters on clear background for emergency. Embossed Dymo-Tape labels are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code. Clean surfaces to receive

nameplates and labels and install nameplates and labels on front of equipment parallel with equipment/raceway/cable/wire/etc. lines.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system voltage and identity of contained circuits on outside of box cover. Color code shall be same as raceway systems. Use self-adhesive marking tape labels at exposed locations and indelible black marker at concealed boxes.

E. Circuit Identification: Tag or label conductors as follows:

1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
2. Multiple Circuits: Where multiple branch circuits, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

F. Apply warning, caution and instruction signs and stencils as follows:

1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

    a. Provide sign at main service entrance switch, indicating type and location of on-site stand-by generator as required by NEC. Sign shall read “Secondary Source Provided by Engine Generator Located in Room NAME and NUMBER”.

G. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

    a. Panelboards, electrical cabinets, and enclosures
    b. Access doors and panels for concealed electrical items

c. Disconnect switches
d. Motor starters
e. Contactors
f. Dimmers
g. Control devices

H. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

I. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.

J. Tag all grounding electrode conductors, associated bonding conductors, and grounding conductors at their point of attachment to any ground bus and grounding electrode (where possible) with a 2-inch diameter round green phenolic nameplate. Lettering shall be 1/4-inch high with 1/4-inch between lines centered on the tag stating "DO NOT DISCONNECT," "MAIN GROUND." Nameplate shall attach to conductor with a short length of small chain.

K. Install labels at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

L. Provide adhesive marking tape labels for identification of individual receptacles including receptacles in furniture systems and light switch wall-plates. Locate tape on front of plate and identify panel and branch circuit serving the receptacle. Provide tape labels for identification of individual switches or thermal overload switches which serve as equipment disconnects. Locate the tape on the front of the cover-plate and identify panel and branch circuit serving the equipment.

M. Provide tape labels on the ceiling grid for lighting control devices located above the grid. Labels shall be gray on white or colored to match grid with light contrast lettering tape.

END OF SECTION 260553

SECTION 260583 – WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. To resistive heaters.
2. From electrical source to motor starters.
3. From motor starters/motor controllers/VFD’s/etc. to motors.
4. To lighting equipment.
5. To converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment.
6. To grounds including earthing connections.
7. Other connections as shown.

1.2 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

1.3 SUBMITTALS:

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials. All mechanical and plumbing equipment shall be coordinated with unit nameplate information of the actual nameplate to be included on the equipment. As a minimum, information shall include: Operating Voltage; MCA (Min. circuit amperes); FLA (Full load amperes); MFS (Max. fuse size) or MOCP (Max. overcurrent protection); and SCCR (Short Circuit Current Rating) and shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings. Bracing for equipment shall be provided at incoming terminals and as an option throughout the equipment for the available fault current or downstream equipment and devices shall be protected by current limiting fuses.

1.4 DEFINITIONS

A. Load voltage wiring shall be defined as:

1. Conduit and wiring required to carry power to motors and other equipment or devices. Wiring from control devices to equipment that carry power to drive that equipment such as line voltage thermostats, etc., shall be included as load voltage wiring. Wiring that provides power to control panels, control transformers, control relays, time clocks, etc., shall also be included as load voltage wiring.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver electrical connection products wrapped in proper factory fabricated type containers.

B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.

C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects by one of the following:

1. ABB
2. Eaton
3. Schneider Electric
4. Siemens Energy & Automation, Inc.

2.2 GENERAL

A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Low Voltage Circuit Protective Devices, with OCPDs adapted to equipment connection installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.

B. Provide motor controllers that are horsepower rated to suit the motor controlled.

C. Contacts shall open each ungrounded connection to the motor. Contacts shall be NEMA rated, 75 degrees C.

D. Overload relays shall be ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which connected with appropriate adjustment for duty cycle and power factor correction supplied with the motor.

2.3 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, disconnect, starter, contactor, relays, etc., and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:

1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type of service. Provide products complying with Division-26 section on Raceways.

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables, and connectors complying with Division-26 section on Wires and Cables.
2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes, ratings, and material of wires/cables which are supplying electrical power.
3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals recommended by equipment manufacturer for intended applications.
4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wire-nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.
5. Cord and Plug Connected Equipment: Where indicated, contractors shall provide a length of SO cord complete with a straight blade or twist-lock receptacle for connection of equipment. Cord and plug rating shall be suitable for the connected equipment load and rating of the branch circuit overcurrent protective device. Plug shall match receptacle configuration included on the plans and cord length shall be as required. Contractor shall connect cord to equipment.

2.4 MANUAL MOTOR STARTERS

A. Manual starters shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Manual starters shall be complete with properly sized overload protection and neon pilot light. Manual starters shall be Square D Class 2510 or Allen-Bradley Bulletin 600 with stainless steel plates. Handles shall be lockable in open and closed position without modification.

B. Heater units in all manual motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.

2.5 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. All equipment with maximum fuse size listed in nameplate shall have fusible disconnect switch provided. Provide NEMA 1 enclosure. For outdoor switches and switches indicated as weatherproof, provide NEMA 3R enclosures with rain-tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

B. Fusible Switches: Provide UL type "HD" 100 percent duty rated switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-

interchangeable feature suitable only for current limiting type fuses. All disconnect switches shall be fusible unless otherwise noted.

C. Non-fusible Disconnects: Provide UL type "HD" 100 percent duty rated switches of classes and current ratings as indicated.

D. Double-Throw Switches: Provide heavy duty switches of classes and current ratings as indicated.

E. Switches for Classified (Hazardous) Locations: Provide heavy duty switches, with UL labels and listings for hazardous location classifications in which installed.

F. Accessories:

1. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated or required.
2. Handles shall be lockable in open and closed position without modification.
3. Disconnect switches provided in the motor feeders between a VFD and the motor shall be provided with auxiliary contacts at the disconnect that de-energizes power to the VFD.

2.6 Motor Starters

A. See Division 23 for Requirements

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Furnish, set in place, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, plumbing and fire protection, elevator, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.

B. Coordinate with other work, including wires/cables, raceway, and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Maintain existing electrical service and feeders to equipment serving occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When

necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of the spliced conductors.

F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torqueing values contained in UL's 486A.

I. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

J. Provide suitable strain relief clamps for cord connection to outlet boxes and equipment connection boxes.

K. Make wiring connections in control panel or in wiring compartment of pre-wired equipment and interconnecting wiring in accordance with manufacturer's instructions.

L. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated or per manufacturer's instructions.

M. Provide each motor with a fused disconnect switch for 3-phase motors and horsepower rated and/or thermal rated disconnect switch for single phase motors as shown on schedules or required. Coordinate with manufacturers of standalone, packaged, and other equipment for factory installed and field installed motors and controllers.

N. Provide circuit and motor disconnect switches as indicated and where required by Code. Comply with switch manufacturers printed installation instructions. Install within sight of motors.

O. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.

P. Each branch circuit serving dedicated, isolated or emergency receptacles, multi-outlet assemblies or equipment connections shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit shall only be permitted where specifically noted.

Q. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

3.4 EQUIPMENT CONNECTION SCHEDULES

A. Mechanical Equipment:

1. Refer to Mechanical Equipment Schedules on the drawings.

END OF SECTION 260583

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of lighting control equipment work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, programmable controllers, data equipment, relays, switches, control wiring, and ancillary equipment.

B. Types of lighting control equipment specified in this section include the following:

1. Occupancy Sensors
2. Manual Modular Dimming Systems
3. Emergency Shunt Relays
4. Photoelectric Relays

C. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings and wiring devices which are required in conjunction with lighting control equipment work.

1.2 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Shop Drawings: Submit layout drawings of lighting control equipment and components including, but not necessarily limited to, programmable controllers, manual override switches and stations, occupancy/vacancy sensors, dimmers, dimmer system components, daylight sensors, transceivers, printers, relays and other switches and equipment. Drawings shall show locations and associated addresses of all devices and equipment. In addition, show spatial relationship of lighting control equipment to other electrical equipment in proximity. List and verify that design sequence of operation and programmability including initial sensor/ programmed on/off times, override control settings, etc., have been provided for each lighting control zone.

C. Submit lists of Ballast/Driver and Lamp combinations compatible with dimmer systems, by manufacturer and catalog number.

D. Wiring Diagrams: Submit wiring diagrams for lighting control equipment and components showing control and interconnection wiring, include connections to equipment components and electrical power feeders. Differentiate between portions of wiring that are manufacturer installed and portions that are field installed. Provide a voltage drop calculation for network cabling to verify EOL voltage compliance.

E. Coordination Drawings: Submit evidence that lighting controls and devices are compatible with connected monitoring and control devices. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

F. Agreement to Maintain: Prior to time of final acceptance, the Installer shall submit an agreement for continued service and maintenance of lighting control equipment, for Owner's possible acceptance.

Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one year period with option for renewal of Agreement by Owner.

G. Maintenance Manuals: Ensure manual includes operating instructions in addition to instructions for maintenance of the system's software package.

H. Commissioning Report: Submit Preliminary and Final Commissioning Report for all Lighting Control Equipment. Preliminary report shall be submitted no later than 90 days of the date of receipt of the certificate of occupancy. Reports shall be organized and include information as required by the current edition of the IECC-International Energy Conservation Code.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with lighting control equipment work similar to that required for this project.

C. Agreement to Maintain: Engage Installer who is willing to execute with the Owner, required agreement for continued maintenance of lighting control equipment.

D. Codes and Standards:

1. Energy Code Compliance: Meet the requirements of the current edition of the IECC-International Energy Conservation Code. In addition, meet any additional requirements of the Local AHJ-Authority Having Jurisdiction.
2. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction, installation of lighting control and communications equipment.
3. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.
4. UL Compliance: Comply with applicable requirements of UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide lighting control equipment and components which are UL listed and labeled. Lighting control panels shall be UL 916 and UL 924 Listed.
5. NEMA Compliance: Comply with applicable requirements of NEMA's Std. Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)."
6. EIA Compliance: Comply with applicable requirements of Electronic Industries Association standards pertaining to telephone and electronic systems.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver lighting control equipment and components in factory fabricated type containers or wrappings, which properly protect equipment from damage.

B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Electrically Held Relays: Equal to 5% of amount installed.
2. Occupancy/Vacancy Sensors: Equal to 5% of the amount installed for each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide lighting control equipment of one of the following (for each type and rating of equipment):

1. Occupancy/Vacancy Sensors:

a. Sensor Switch
b. Leviton
c. Lutron
d. Hubbell
e. WattStopper (The)

2. Manual Modular Dimming Systems:

a. Lutron
b. Crestron
c. Leviton

3. Automatic Load Control Relays (ALCR) and Emergency Shunt Relays (ESR):

a. WattStopper (The)
b. LVS

2.2 Occupancy/vacancy Sensors

A. Wall or ceiling-mounting, solid-state units with a separate relay unit.

1. Passive Infrared, Ultrasonic, Microphonic, or Dual Technology. Provide Dual Technology Devices unless otherwise shown. Spacing and coverage per the manufacturer’s recommendations.
2. Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

4. Relay Unit: Dry contacts rated for 20-A ballast/driver load at 120- and 277-V ac.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Controlled Receptacles: Provide auxiliary relay(s) as required to automatically operate controlled receptacles. Refer to the drawings and Specification Section 262726 Wiring Devices for more information.

2.3 MANUAL MODULAR DIMMING SYSTEMs

1. Factory-fabricated equipment providing 1 to 4 channels of manual dimming control as indicated. Common on-off switching and components into a 2- or 3-gang wall box under a single flush wall plate.
2. System to be listed for control of the type of lighting unit used.
3. Fluorescent dimmers to control lights smoothly over a range of 100 percent to 10 percent of full brightness.
4. Unit to be rated at 1900 watts, minimum with each dimming channel rated 600 watts, minimum.

2.4 Automatic Load COntrol Relays (ALCR)/ EMERGENCY Shunt relay UNITS (ESR)

A. Self-contained ALCR/ESR units shall comply with and be listed under UL 924.

1. Operation: Normally closed electrically held relay to be wired in parallel with control switch/relay. Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Unless otherwise indicated ALCR/ESR shall control as follows:

    a. Emergency luminaires shown in rooms with other switched luminaires (Not indicated “NL” (night light) and/or connected to an always on emergency circuit) provide ALCR/ESR to allow indicated control of all luminaires in space. Provide room controller or other devices necessary to accommodate dimming and other control equipment and requirements. Emergency lights in space shall be brought to full brightness from emergency circuit whenever the normal circuit serving the room loses voltage. Sensing from panelboard feeders is not acceptable; sensing shall be accomplished at the branch circuit level. Normal lighting and controls shall be restored automatically when normal power is available.
    b. Egress lighting shall meet requirements of NFPA 101.
    c.

2. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
3. LED Indicator Light: Indicates status of normal and emergency power.

2.5 PHOTOELECTRIC SENSORS

A. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photo-resistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Light-Level Monitoring Range: 10 to 1000 fc with an adjustment for turn-on and turn-off levels within that range.

3. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead-band adjustment.

2.6 Wireless Equipment

A. Wireless equipment and equipment containing batteries shall only be allowed where specifically shown or indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which lighting control equipment is to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION OF LIGHTING CONTROL EQUIPMENT

A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.

B. Low voltage control wiring terminations shall be made within electrical boxes.

C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Interconnect lighting control equipment with building management system, after lighting equipment installation work has been completed and is operating properly. Define groups in the lighting control system to interface with the building management system as indicated on the temperature control matrix.

E. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and B.

F. Co-locate equipment as much as practical for ease of maintenance.

G. Ceiling cavity relays, room controllers, and similar devices to be mounted above or near the door to the room. Indicate device locations on the as-built drawings. Provide adhesive marking tape labels on the ceiling grid at device locations. Refer to Section 260553 Identification for Electrical Systems for additional requirements..

H. Provide hardwired connections to each device, controller, sensor, etc. for control connections.

3.3 GROUNDING

A. Provide equipment grounding connections for lighting control equipment as indicated. Tighten connectors to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Testing and retesting at no cost to Owner.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust all field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing with commissioning report.

C. Perform the following field tests and inspections for each piece of equipment and each device and prepare test reports:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by facilities.

D. Commissioning Report: Provide Commissioning services required to provide Preliminary and Final Commissioning Report for all Lighting Control Equipment. Preliminary report shall be submitted no later than 90 days of the date of receipt of the certificate of occupancy. Testing and Reports shall be organized and include information as required by the current edition of the IECC.

E. Testing and training shall be provided at times scheduled with the owner and may need to be done off hours.

3.5 PERSONNEL TRAINING

A. Manufacturer's Field Service indicated above shall include Owner’s maintenance personnel.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software.

C. Provide extra scheduled time with owner to make corrections to the system to meet the functionality/time control requirements desired by the owner. Record any changes in the Testing and Equipment Settings Report and submit final documents.

END OF SECTION 260923

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Ground-fault circuit interrupters.
3. Switches.
4. Wall-plates.
5. Dimmers.
6. Plugs and connectors.

1.2 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.

C. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Samples of device plates for color selection and evaluation of technical features shall be submitted.

1.4 COORDINATION

A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.

B. Cord and Plug sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Products shall be of the same manufacturer insofar as possible. Subject to compliance with requirements, provide wiring devices of one of the following:

1. Devices, Cover Plates, Accessories:

a. Hubbell Inc.
b. Leviton Mfg. Co.
c. Legrand
d. Eaton
e. Abb

2. Weatherproof Receptacle Covers:

a. Hubbell, Inc.
b. Legrand
c. Eaton
d. Leviton

2.2 WIRING DEVICES

A. Color selection shall be verified with Architect/Engineer prior to ordering. Devices shall be Ivory. All receptacles and switches connected to circuits served from a generator system shall have a red face.

B. Receptacles:

1. All duplex, single, Isolated Ground, Tamper Resistant, Ground Fault Interrupter (GFCI), Controlled, and other special receptacles shall be minimum, specification grade commercial series, listed by Underwriter's Laboratories, UL 498 and Federal Specification FS W-C-596, 20-amp, nylon face and have a metal mounting strap with self-grounding and have a hex-head green grounding screw and be side and back wired. Each device shall bear the UL/FS Label. Meet NEMA standards for wiring devices including NEMA WD 1 for general requirements and NEMA WD 6 for dimensional standards.

a. Each device shall have terminal screws and clamps listed for use with stranded wire.

2. Convenience Receptacle Configuration: Duplex or Single as indicated on the drawings, Type 5-20R.
3. Weather Resistant Receptacles: In addition to the above requirements all receptacles in damp and wet locations shall be WR (Weather Resistant) labeled.
4. Special Purpose Receptacle Configuration: straight blade or locking as indicated on drawings, black face.
5. Tamper Resistant Receptacles: Where indicated or required provide Duplex receptacle with integral switch and contacts to prevent energization unless a plug is inserted. Provide receptacles that are UL listed and labeled “TR”.
6. Ground Fault Interrupter Receptacles: Where indicated or required provide "local reset" auto monitoring “self-test” ground fault circuit interrupters. Provide unit capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943. Provide visual indication of lost protection.

7. Receptacles, Industrial Heavy-Duty: Where indicated or required provide connectors that Conform to NEMA Standard PK 4 "Plugs, Receptacles, and cable Connectors of the Pin and Sleeve Type for Industrial Use."
8. Pendant Cord/Connector Devices: Matching, locking type, plug and plug receptacle body connector, NEMA L5-20P and L5-20R, heavy-duty grade.

    a. Bodies: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
    b. External Cable Grip: Woven wire mesh type made of high strength galvanized-steel wire strand and matched to cable diameter and with attached provision designed for the corresponding connector.

9. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.

    a. Cord: Rubber-insulated, stranded copper conductors, with type-SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30% minimum.
    b. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.

C. Switches:

1. Wall Switches for Lighting Circuits: NEMA WD1 and WD-6; FS W-S-896E; AC quiet type specification grade commercial series listed by Underwriter's Laboratories with toggle handle, rated 20 amperes at 120-277 volts AC, unless noted otherwise. Mounting straps shall be metal and be equipped with a green hex-head ground screw. Each switch shall bear the UL/FS Label.

    a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug Tail device connections are acceptable.

D. LED Lamp Dimmers: Provide UL listed single-pole, full-wave semi-conductor modular type AC dimmers; wattage and voltage as indicated, and with electromagnetic filters to reduce noise, RF and TV interference to minimum. Coordinate type for 0-10V LED Drivers and LED’s. Provide with power failure memory. Dimmers shall be Lutron "Diva Series".

2.3 WIRING DEVICE ACCESSORIES

A. Verify color and type with Architect/Engineer prior to ordering. Device color to match Wiring Device Color identified above. Verify location, height, mounting conditions, etc., of all devices with Architectural drawings prior to rough-in.

B. Wall-plates: Provide wall-plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Identify all wall plates used for receptacles with branch circuit number per requirements of section on Electrical Identification. Provide blank wall plates for all cable, data, telephone and junction and outlet boxes. Where cables are routed through the wall-plate, provide grommets in wall-plate openings to protect cables. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04" thick, type 302 satin finished stainless steel OR Nylon, smooth. Confirm with architect prior to ordering and bidding.

2. Material and Finish: 0.04" thick, type 302 satin finished stainless steel for use in unfinished areas, mechanical, and electrical rooms.
3. Material and Finish: 0.04" thick brass, brushed chrome, or satin chrome where indicated.
4. Cast Metal or Aluminum: Die cast profile, ribbed for strength, flash removed, primed with gray enamel.
5. Gaskets: Resilient rubber or closed cell foam urethane.
6. Weatherproof, Exterior and other wet locations and where called out on the drawings as “WP”, provide weatherproof junction box with gaskets and cover.

    a. “In Use” type: Cover shall be rated “while in use”. Use low profile type covers with UV rated and resistant polycarbonate.
    b. Outlet box hood shall be listed as “extra duty”.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes, and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean, free from excess building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall-plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.

G. Provide GFCI type outlets as shown and as required in the NEC including article 210, including but not limited to: each above counter duplex receptacle shown within 6 feet-0 inches of sinks/lavatories; Bathrooms; Kitchens; Roof Tops; Outdoors; Indoor Wet locations; Locker Rooms; Shower Facilities; Garages; Service Bays; vending machines; etc. For above counter multi-outlet assemblies which do not contain duplex receptacles that can be replaced with GFCI devices, provide GFCI circuit breakers on the branch circuit(s) feeding the assembly. Where GFCI devices are required and/or shown but are not readily accessible when equipment is installed, i.e., vending machines, etc., provide blank face GFCI device and cover-plate ahead of inaccessible receptacles. Mount adjacent to equipment at switch height unless otherwise shown. Install individual GFCI devices at each location shown, feed through devices are only acceptable where specifically called for.

H. Provide tamper resistant receptacles as shown and required including dwelling units; guest rooms; childcare facilities; preschools/educational facilities; business offices, corridors, waiting rooms, etc. in clinics, medical and dental offices, outpatient facilities, health care facilities including patient rooms, bathrooms, playrooms, activity rooms, and pediatric patient rooms other than nurseries, and subset of assembly occupancies.

I. Receptacle Mounting: Mount device with front of device flush with the cover plate. Over the counter receptacles shall be mounted horizontally with ground to the right. All receptacles shall be oriented consistently (i.e., ground pin up or to the right). Where switch and receptacles are mounted within one stud space align vertically. Vertically mounted receptacles shall be mounted with ground up.

J. Switch Mounting: Switches shall be ganged and within 18” of the door jam on the strike side of the door openings unless otherwise shown. Verify door swings with Architectural drawings prior to rough-in. Switches connected to the life safety system shall not be ganged with other switches. Switch and receptacle combinations shall be installed in a 2-gang box where both are of the same voltage. provide separate boxes where different voltages are present.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

A. Upon installation of wall-plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.4 CLEANING

A. Internally clean devices, device outlet boxes and enclosures. Replace stained, cracked, damaged or improperly painted wall plates or devices. Remove temporary markings of labels.

3.5 TESTING

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained and prepare test reports. After energization, test wiring devices to demonstrate compliance with requirements.

1. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems.
2. Tests for Convenience Receptacles:

    a. Line Voltage: Acceptable range is 114 to 126 V.
    b. Ground Impedance: Values of up to 2 ohms are acceptable.
    c. Polarity: Test for correct neutral conduct to neutral terminal connection.
    d. Using the test plug, verify that the device and its outlet box are securely mounted.
    e. GFCI Receptacles: Test for tripping values specified in UL 1436 and UL 943. Test with both local and remote fault simulations in accordance with manufacturing recommendations.

3.
4. Test Instruments:

    a. Use instruments that comply with UL 1436.

b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Correct Deficiencies and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace devices as required to bring system into compliance.
2. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Prepare a report that identifies enclosure, units, conductors, and devices checked and describe results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 262726

SECTION 262800 - LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes overcurrent protective devices (OCPD's) rated 600 V and below and switching devices commonly used with them.

B. Panelboards and Switchboards: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 26 sections.

1.2 DEFINITIONS

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

B. Ampere Squared Seconds: An expression of available thermal energy resulting from current flow. With regard to current limiting fuses and circuit breakers, the ampere squared seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.3 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time current curves for all protective devices and let through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

C. Submit documentation of compliance with Code and Specification requirements for circuit protective devices including but not limited to SCCR, Listings for use with downstream breakers/fuses and equipment where required, Ground Fault protection; Arc Flash reduction for breakers above 1200A; Surge Protection; Metering; Relaying; etc.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Each type of OCPD shall be the product of a single manufacturer.

1.5 EXTRA MATERIALS

A. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cartridge Fuses:

a. Bussmann Div., Cooper Industries, Inc.
b. Littelfuse Inc.
c. Mersen

2. Fusible Switches:

a. ABB
b. Schneider Electric
c. Siemens
d. Eaton

3. Circuit Breakers:

a. Schneider Electric
b. ABB
c. Siemens
d. Eaton

4. When mounting overcurrent protective devices in switchboards, switchgear, panelboards, MCCs, etc., provide equipment of same manufacturer as equipment into which they are being mounted.

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL

A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and as individually enclosed and mounted single units.

B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

C. Where OCPDs are to be installed in existing panelboards, switchboards, and motor control centers, they shall be of the same manufacture and type as those existing in the equipment. If this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.

D. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.

E. Ground Fault Protection: Distribution circuit breakers: provide integral, self-powered type with mechanical ground fault indicator, test function, adjustable pickup current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated or required. Provide combination devices for branch circuit protection as follows; where shown or required provide 30 mA Ground Fault circuit breakers for each circuit feeding Electrical Heat Trace to protect from overheating and fire and 5 mA Ground Fault circuit breakers for each circuit feeding receptacles to protect personnel. Coordinate with manufacturer’s instructions.

2.3 CARTRIDGE FUSES

A. General: NEMA Standard FU1, "Low Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. All fuses used for main, feeder, or branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled. Fuses used for supplementary protection (other than branch circuit protection) shall be as specified above or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.

C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.

D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.

E. Class L Fuses: UL 198C, "High Interrupting Capacity Fuses, Current Limiting Type."

F. Class RK1 Dual Element Time Delay Fuses: UL 198E, "Class R Fuses."

G. Class J Low-Peak dual Element Fuse: UL 198C

2.4 NONFUSIBLE SWITCHES

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break, heavy duty units.

B. Rating: Load breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the available.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

G. Contacts shall be NEMA rated 75 degrees C.

H. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.5 FUSIBLE SWITCHES

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break, heavy duty units.

B. Rating: Load breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the let through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Fuse Clips: Rejection type.

G. Enclosure for Switchboard or Panel board Mounting: Suitable for panel mounting where indicated.

H. Enclosure for Independent Mounting: Provide NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

I. Contacts shall be NEMA rated 75 degrees C.

J. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.

K. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.6 MOLDED-CASE CIRCUIT BREAKERS

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Provide bolt-in type, except breakers 225ampere frame size and larger which may be plugin type if held in place by positive locking device requiring mechanical release for removal.

C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.

D. Tripping Device: Quick-make, quick--break toggle mechanism with inverse- -time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 200 amperes or larger. Breakers 150 amperes and above shall have adjustable trip selection for trip units. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low trip setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.

F. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

G. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.

H. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

2.7 COMBINATION CIRCUIT BREAKERS AND GROUND FAULT CIRCUIT INTERRUPTERS

A. General: UL 943 "Ground Fault Circuit Interrupters," arranged for sensing and tripping for ground fault current in addition to overcurrent and short circuit current. Provide features as follows:

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2.8 OCPD ACCESSORIES

A. Provide shunt trip devices for Circuit breakers where required or indicated. Arrange to trip breaker from an external source of power through a control switch or relay contact.

B. Lock-Out Devices: Provide padlocking provisions on each overcurrent protective device, lockable in the open or closed position. Provide 3 sets of lockout/tagout devices for each type of breaker or switch provided. Include tags, locks and all accessories necessary.

C. Provide lock-on device for circuit breakers serving fire alarm panels per NFPA 72. Device shall be red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions. Install OCPDs level and plumb.

B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPDs in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.

C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.

D. All fuses for new disconnect switches or MCCs feeding motors or motor starters shall be provided with Class J fuses.

E. OCPDs and mounting accessories installed in existing equipment shall match the existing manufacturer and be rated for the available fault current.

3.2 IDENTIFICATION

A. Identify components in accordance with Division 26 Section on electrical identification.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between OCPDs and control/indication devices.

3.4 CONNECTIONS

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL

A. Reports: Prepare written reports on tests and observations. Report defective materials and workmanship, and unsatisfactory test results. Include complete records of repairs and adjustments made. Tests shall be made on all new and existing OCPDs provided and/or connected under this project in accordance with this section.

B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

C. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

D. Upon completing installation of the system, perform the following tests on all new equipment and existing equipment as indicated on the drawings:

1. Visual and mechanical inspection: Include the following inspections and related work.

    a. Overcurrent Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters.
    b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
    c. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
    d. Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
    e. Clean OCPDs using manufacturer's approved methods and materials.
    f. Verify installation of proper fuse types and ratings in fusible OCPDs.

2. Electrical Tests: Perform the following tests in accordance with manufacturer's instructions:

    a. Insulation resistance test of fused power circuit devices insulated case, and molded case circuit breakers, 600ampere frame size and over at 1000 degree V D.C. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
    b. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
    c. Make continuity tests of circuits.

E. Make adjustments for final settings of adjustable trip devices.

F. Activate auxiliary protective devices such as ground fault or under-voltage relays, to verify operation of shunt trip devices.

G. Check stored energy charging motors for proper operation of motor, mechanism, and limit switches.

H. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.

I. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked open and opening attempts on locked closed devices including moveable barriers and shutters.

J. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.

3.7 CLEANING

A. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION

A. Training**:** Demonstrate OCPDs and train Owner's maintenance personnel.

B. Conduct a minimum of one-half day of training in operation and maintenance as specified under in the Project Closeout Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.

C. Schedule training with at least seven days' advance notification.

END OF SECTION 262800

SECTION 265000 – LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Extent, location, and details of lighting work are indicated on drawings and in schedules.

1. Types of lighting in this section include the following: Light Emitting Diode (LED)

1.2 SUBMITTALS

A. See Section 260500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Shop Drawings: Submit layout drawings of lighting and their spatial relationship to each other. In addition, submit luminaire cut sheets from the manufacturer. For standard products submit shop drawings; for non-standard products submit in booklet form with separate sheet for each luminaire, assembled by "luminaire type" with proposed luminaire and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system. Shop drawings shall detail luminaire dimensions, weights, methods of field assembly, mounting components, features, and accessories. All features and accessories shall be clearly defined.

C. Wiring Diagrams: Submit wiring diagrams for lighting showing connections to electrical power panels, switches, dimmers, controllers, and feeders. Differentiate between portions of wiring which are manufacturer installed- and portions which are field-installed.

D. Samples: Submit one complete operating unit for each type of custom luminaire specified.

E. Illumination Data: Submit lighting calculations identified below for all products not listed first in the luminaire schedule and where otherwise noted.

1. Interior: Provide isofootcandle (isolux) plot diagram of footcandles on horizontal work plane surface which shows composite values of illuminance projected from the arrangement of light sources from indicated luminaire locations and heights. Show on the graphic plots the locations, spacing’s and heights of luminaires. Indicate values of maximum, average, minimum, max/min ratios, and Lumen Maintenance factor utilized.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with lighting work similar to that required for this project.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver lighting in factory fabricated containers or wrappings, which properly protect luminaires from damage.

B. Store lighting in original packaging. Store inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.

C. Handle lighting carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting with other work.

B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

1.6 EXTRA MATERIALS

A. Drivers: Furnish stock or replacement ballasts amounting to 5%, but not less than 2 of each type used in each type of luminaire.

B. Lenses: Furnish stock or replacement lenses amounting to 3%, but not less than one of each type and size used in each type of luminaire.

C. LED Modules: Furnish replacement modules amounting to 3% of each type.

D. Deliver replacement stock as directed to Owner's storage space.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Luminaire Manufacturers: Subject to compliance with requirements, provide luminaires as listed in the luminaire schedule or elsewhere on the drawings or specification.

B. LED Manufactures:

1. Philips Lighting Co.
2. Lumileds
3. CREE
4. Nichia
5. Osram Sylvania

C. Driver Manufacturers:

1. Osram Sylvania
2. Signify / Advance

3. Philips Lighting Co.

D. All other manufacturers shall request prior approval and supply test data from an independent testing laboratory and comparison report to substantiate compliance with specifications and specified equipment.

2.2 EQUIPMENT

A. General: Provide lighting of sizes, types and ratings indicated; complete with, but not limited to, housings, LED Modules, reflectors, drivers, and wiring. Ship luminaires factory assembled, with those components required for a complete installation. Design luminaire with concealed hinges and catches, with metal parts grounded as common unit.

1. LEDs shall retain 70% of lamp life after 50,000 hours. LEDs shall be binned to NEMA standard SSL 3-2010. The LED light assembly shall be replaceable separate from the luminaire housing. The LED driver shall be dimming where indicated on the drawings.
2. All LED products and information to be in accordance with IES Standards LM79 & LM80.
3. Provide all luminaires with CRI 80 or higher unless otherwise indicated.
4. Provide quantity of drivers required to accommodate switching arrangements as shown on the drawings.
5. Provide emergency battery test switches for recessed down lights always adjacent to down light unless otherwise noted.
6. Provide multi-voltage compatible drivers for all luminaires which can be specified as such.

B. LED Drivers: THD less than 10%. All 0-10V drivers shall be provided with isolation on the secondary analog side to eliminate secondary voltage on the 0-10V channel. Drivers shall be flicker free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which lighting is to be installed, and substrate for supporting lighting. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

A. Install lighting at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.

B. Provide luminaires and/or outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Architect.

1. Luminaires shall be positively attached to the suspended ceiling system. The attachment device shall have a capacity of 100% of the luminaire weight acting in any direction.
2. When intermediate systems are used, No. 12 gauge hangers shall be attached to the grid members within 3" of each corner of each luminaire.

3. When heavy-duty systems are used, supplemental hangers are not required if a 48" modular hanger pattern is followed. When cross runners are used without supplemental hangers to support luminaires, these cross runners shall provide the same carrying capacity as the main runner.
4. Luminaires weighing less than 56 pounds shall have, in addition to the requirements above, two No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.
5. Luminaires weighing 56 pounds or more shall be supported directly from the structure above by four No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.

C. Install flush mounted luminaires properly to eliminate light leakage between frame and finished surface.

D. Provide plaster frames for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

E. Fasten luminaires securely to structural supports; and ensure that pendant luminaires are plumb and level. Provide individually mounted pendant luminaires longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum one-inch vertical adjustment. Mount continuous rows of luminaires with an additional stem hanger greater than number of luminaires in the row.

1. Pendant hung luminaires shall be supported directly from the structure above with No. 9 gauge wire or approved alternate support without using the ceiling suspension system for direct support.
2. Luminaires mounted in areas of high seismic activity shall be mounted from a rigid stem to restrain sway. If mounted from a non-rigid stem, luminaires to be mounted such that their sway under seismic conditions does not impact another luminaire within 45˚ swing from nadir.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.

G. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box stud.

H. Set units plumb, square, level and secure according to manufacturer’s written instructions and shop drawings.

3.3 FIELD QUALITY CONTROL

A. Replace defective and luminaires for a period of one year following the date of substantial completion.

3.4 ADJUSTING AND CLEANING

A. Clean lighting of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses and reflectors.

B. Protect installed luminaires from damage during remainder of construction period.

C. Adjust aimable luminaires to provide required light intensities and in compliance with design intent.

3.5 GROUNDING:

A. Provide equipment grounding connections for lighting as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

B. Ground luminaires according to Section 260526, "Grounding,".

3.6 WARRANTY

A. The Contractor shall guarantee all equipment including drivers, LEDs, luminaires, wiring, etc. free from inherent mechanical and electrical defects. Warranty period shall be from date of acceptance as set forth in the general conditions with periods as follows:

1. Luminaires, wiring, etc. - 1 year
2. LED and Driver – Five-year manufacturer’s warranty.

3.7 DEMONSTRATION

A. Upon completion of installation of lighting and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 265000

SECTION 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 Related documents

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 27 and 28 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Related Sections: Refer to all sections in Division 27, 28. Refer to Division 26 specification sections and Division 26 drawings.

C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 REFERENCES

A. Design and installation requirements

1. The following standards contain provisions which, through reference in these specifications, constitute mandatory requirements within these specifications. At the time of publication of these specifications, the editions listed were all valid, but all standards are subject to revision, and contractors shall be required to conform to the most recent provisions of the standards indicated below. ANSI and TIA maintain registers of currently valid national standards published by them. Contractor shall execute all work to be performed in compliance with all international, federal, state, county, and local municipality standards. Those standards include, but shall not be limited to the latest version/publication of the following:

    1) TIA-568.0-D Generic Telecommunications Cabling for Customer Premises
    2) TIA-568.1-D Commercial Building Telecommunications Infrastructure Standard
    3) TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards
    4) TIA-568.3-D Optical Fiber Cabling Components Standard
    5) TIA-568-C.4 Broadband Coaxial Cabling and Components Standard
    6) TIA-569d Telecommunication Pathways and Spaces
    7) TIA-570c Residential Telecommunications Infrastructure Standard
    8) TIA-606b Administration Standard for Telecommunications Infrastructure
    9) TIA-607c Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises
    10) TIA-758b Customer-Owned Outside Plant Telecommunications Infrastructure Standard
    11) TIA-862b Structured Cabling Infrastructure Standard for Intelligent Building Systems
    12) TIA-942a Telecommunications Infrastructure Standard for Data Centers
    13) TIA-526-14c Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant

14) TIA-526-7a Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
15) TIA-598d Optical Fiber Cable Color Coding
16) BICSI Telecommunications Distribution Methods Manual (Latest Edition)
17) BICSI's ICT Terminology Handbook (Latest Edition)
18) ANSI / NECA / BICSI Standard for Installing Commercial Building Telecommunications Cabling (Latest Edition)
19) NECA / BICSI Standard for Telecommunications Grounding Planning and Installation Methods For Commercial Buildings (Latest Edition)
20) NFPA 70: National Electrical Code (NEC) (Latest Edition)
21) NEMA VE 1 metal cable tray systems
22) NEMA VE 2 cable tray installation guidelines

NOTE: In the event that owner and/or the local AHJ over electrical code interpretation / enforcement shall not have adopted this most recent version of NFPA 70, the contractor shall determine the ruling edition of this code that shall be applied for this project and notify the Technology Consultant in writing of the specific edition of this code to be applied.

1.3 DEFINITIONS

A. Above Finished Floor (AFF) – Standard mounting height or vertical distance (e.g., 48" AFF) for a fixture, ceiling, device, or any other object measured from the finished floor surface to the center line of the object as a measurement point. (BICSI TDMM)

B. Administration - The methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements, and the process by which Moves, Additions, and Changes (MACs) are recorded. (ISO)

C. Backbone - A facility (e.g., pathway, cable, conductors, optical fibers) between any of the following spaces: Telecommunication Rooms (TRs), Telecommunication Enclosures (TEs), common TRs, floor-serving terminal, Entrance Facilities (EFs), Equipment Rooms (ERs), and common ERs.

D. Cable Labeling System – 1. The scheme employed when identifying cable or its associated hardware. 2. Scheme adapted for labeling cables to identify them based on TIA-606B, *Administration Standard for Commercial Telecommunications Infrastructure.*

E. Category 6 – Balanced twisted-pair cabling specifications characterized in a frequency range from 1 to 250 MHz.

F. Category 6A (augmented) - Balanced twisted-pair cabling specifications characterized in a frequency range from 1 to 500 MHz, this cabling features extended frequency range and alien crosstalk transmission parameters.

G. Entrance Facility (EF) – 1. An entrance to a building for both public and private network service cables (including wireless) including the entrance point of the building and continuing to the entrance room or space. (TIA) 2. A facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and that complies with all relevant regulations. (ISO)

H. Equipment Room (ER) – An environmentally-controlled, centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect. (TIA)

I. Firestopping – The process of installing listed fire-rated materials into penetrations in fire-rated barriers to reestablish the fire-resistance rating of the barrier. (TIA)

J. Floor Distributor (FD) – The distributor used to connect horizontal cable and cabling subsystems or equipment. International equivalent term for horizontal cross-connect. (BICSI TDMM)

K. Handhole (HH) – A structure similar to a small maintenance hole in which cable can be pulled, but not large enough for a person to fully enter to perform work. (BICSI TDMM)

L. Horizontal Cable – Distribution media that connect the telecommunications outlet / connector at the work area and the first piece of connecting hardware in the horizontal cross-connect / floor distributor. (BICSI TDMM)

M. Horizontal Subsystem – The horizontal subsystem provides connections from the horizontal cross-connect to the Workstation Outlets (WSOs) in the work areas. It consists of the horizontal transmission media, the associated connecting hardware terminating this media, and the WSOs in the work area. Typically, each floor of a building is served by its own horizontal subsystem.

N. Maintenance Hole (MH) – 1. A vault located in the ground or earth as part of an underground duct system and used to facilitate placing, connectorization, and maintenance of cables as well as the placing of associated equipment, in which it is expected that a person will enter to perform work. (TIA) Formerly called manhole. 2. A hole through which an underground or enclosed structure may be used.

O. Record Drawing – A plan, either electronically-generated or on paper, that graphically documents and illustrates the installed telecommunications infrastructure in a building, or portion thereof. (TIA)

P. Shop Drawing – These drawings may be prepared by the contractor, subcontractor, or material / equipment supplier, and show how a particular aspect of the work is to be fabricated or installed.

Q. Submittal – Information, documentation, or samples that a contractor may be requested to submit to the design team for review and approval before the commencement of work. (BICSI TDMM)

R. Telecommunications Bonding Backbone (TBB) – A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding Busbar (TGB). (TIA)

S. Telecommunications Grounding Busbar (TGB) – A common point of connections for telecommunications systems and equipment bonding to ground and located in the telecommunications room or equipment room. (TIA)

T. Telecommunications Main Grounding Busbar (TMGB) – A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground. (TIA)

U. Telecommunications Room (TR) – An enclosed architectural space for housing telecommunications equipment, cable terminations, and cross-connect cabling. (TIA)

V. Workstation Outlet (WSO) – A connecting device for termination of horizontal media, also known as Work Area Outlet. (BICSI TDMM)

1.4 SUBMITTALS

A. Product Data

1. Product submittals shall be prepared by the Contractor to identify all products proposed for installation on this project as identified in all individual specification sections within Part 2 – PRODUCTS, and as more specifically defined within Specification Sections 27 06 00 – Schedules for Communications and 28 06 00 – Schedules for Electronic Safety & Security.
2. Product submittals (which shall at a minimum) shall include manufacturer's catalog and / or performance data sheets and be prepared by Contractor and provided as further detailed on drawings / described in project specifications, General and Supplementary Conditions of the Contract. Data provided shall include information that details dimensions, colors, and configurations. Preferably, submittal data shall include performance test results gathered and prepared by an independent testing company.

B. Quality Control Submittals

1. Manufacturer's Instructions

a. Contractor shall adhere to manufacturer's instructions for storage, handling, protection, examination, preparation, operation, and installation of all products.

1.5 QUALITY ASSURANCE

A. Qualifications

1. As documentation provided within their proposal response, Contractor shall provide project references (project name, location, scope, start and end dates, contact name / phone # / e-mail) to demonstrate a minimum of five (5) years of experience on technology systems of similar type and size.

B. Regulatory Requirements – See Division 01 41 00 Regulatory Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading – see Division 01 65 00 Product Delivery Requirements.

B. Acceptance at Site - see Division 01 65 00 Product Delivery Requirements.

C. Storage and Protection – see Division 01 66 00 Product Storage and Handling Requirements.

D. Waste Management and Disposal

1. On a daily basis, and at the completion of the system, the Contractor shall remove all waste, excess materials, rubbish, debris, tools, and equipment used during the installation / services provided under this Contract.
2. If the Contractor fails to perform its duties under this provision, the Owner may upon written notice to Contractor perform the necessary cleanup and deduct the costs thereof from any payments due or to become due to the Contractor.
3. See Division 01 74 00 Cleaning and Waste Management.

1.7 PROJECT / SITE CONDITIONS

A. Environmental Requirements – see Division 01 35 00 Special Procedures.

B. Existing Conditions – see Division 01 50 00 Temporary Facilities and Controls.

1.8 technology submittal checklist

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision at Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
270500	Common Work Results for Communications		X						
270528	Pathways for Communications Systems		X	X					
Notes:	Refer to Technology Drawings for inclusion of systems above. Product Data and Shop Drawing Submittals to be submitted as separate packages. Product Data and Shop Drawing Packages to be submitted at the same time.								

PART 2 - NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions

1. Prior to the commencement of any installation by any technology systems contractor, the Contractor shall provide a written acceptance to the Technology Consultant that the Contractor has inspected the site conditions, and those conditions are deemed appropriate for the installation to begin in protection of the Owner's investment.

3.2 PREPARATION

A. Protection

1. Contractor shall make no penetrations thru floors, walls, or ceilings without prior written consent of the General Contractor and the Technology Consultant.

B. Surface Preparation

1. Where penetrations thru floors, walls, ceilings, or fire-rated barriers have been provided to Contractor, or made by the Contractor, such penetrations shall be sealed in accordance with the applicable code requirements, and as directed in writing by the General Contractor and the Technology Consultant.
2. Prior to commencement of installation of any conduits, cable trays, or cabling thru any fire-rated barriers, the Contractor shall submit detailed plans on a per location basis with the specific fire-rated assemblies or materials that are planned for installation. Installation shall not proceed for

fire-rated penetration assemblies or materials prior to the written approval by the General Contractor and the Technology Consultant.

3.3 ERECTION / INSTALLATION / CONSTRUCTION

A. Interface with Other Work

1. Contractor shall provide a single point of contact (e.g., Project Manager) to represent the Contractor for communication / supervision of the work as follows:

    a. Initiate and coordinate work tasks and verbal / written communication with the Owner, General Contractor, other Contractors, Subcontractors, and others as directed by the Owner.
    b. Provide day-to-day direction and supervision of onsite Contractor / Subcontractor personnel.
    c. Maintain a safe working environment for all direct work, and to immediately report in writing all potentially unsafe working conditions to the General Contractor.

3.4 REPAIR AND RESTORATION

A. The Contractor shall be responsible to repair and/or restore any damaged portions of the building caused by its employees, contractors, and subcontractors, including but not limited to:

1. Damage caused to any portion of the project site caused by the movement of tools, materials, or equipment.
2. Damage to any spaces, components, or systems made available to the Contractor for the performance of work.
3. Damage to materials, tools, or equipment of the Owner, General Contractor, other Contractors, Subcontractors, Vendors, Agents, or Lessees.

B. Inspection

1. Contractor shall provide not less than one-week advanced notice prior to commencement of each incremental stage of the installation activities, so that the Owner’s Representative / Technology Consultant can be present to observe any / all installation activities.

END OF SECTION 270500

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hooks.
2. Adjustable Cable Supports.
3. Metal conduits and fittings.
4. Nonmetallic conduits and fittings.
5. Optical-fiber-cable pathways and fittings.

1.3 DEFINITIONS

A. ANSI: American National Standards Institute.

B. AWG: American wire gauge.

C. BICSI: Building Industry Consulting Service International.

D. NECA: National Electrical Contractors Association.

E. NFPA: National Fire Protection Agency.

F. TIA: Telecommunications Industry Association.

G. UL: Underwriters Laboratory.

1.4 SUBMITTALS

A. Shop Drawings: For conduit routing, sizing, and pathway

1. Submit cut-sheets for each of the pathway products bid for review.
2. Show floor plan drawings with all pathway routing with distances and locations of all low voltage conduit in scope in PDF format for review prior to installation.
3. Provide one (1) full size and one (1) half size set hard copy and a soft CAD copy As Built of all field routing of conduit, cabling and tray system drawings per Substantial Completion.

B. Product Data: Provide component descriptions and describe electrical characteristics of components.

C. Warranty: Ensure all warranties specify that the Owner is entitled to all rights guaranteed by the warranty for various components.

D. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings before installation.

1) Coordination Drawings: Coordinate layout and installation of cable tray with other installations. Revise locations and elevations from those indicated as required to suit field conditions, only as approved by the Architect and Engineer. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:

b. Vertical and horizontal offsets and transitions.
c. Clearances for access above and to sides of cable trays.
d. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Classified and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Ensure manufacturers comply with ISO 9001 quality standards.

C. Comply with NFPA 70, National Electric Code, Article 392: Cable Trays; provide UL Classification and labels.

D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.

E. Comply with NEMA VE 1, Metal Cable Tray Systems, for materials, sizes, and configurations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS

A. Subject to owner's final approval of bid responses submitted by contractor, the following manufacturer's products will be considered in bid responses; and as compliant to these technical specifications. In order to assure achievement of maximum system performance, individual components must be performance-certified to match interfacing and interactive components. Products must not be mixed and matched between different vendors. Vendor solutions must be implemented as single vendor end-to-end engineered systems to assure compatibility.

2.3 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. J-hooks shall be installed at a maximum of 5-foot intervals to support and distribute the cable's weight.

C. J-hooks shall be installed to ensure horizontal pathways or cables do not rest directly on the ceiling panels, support channels, ceiling support wires, HVAC ducts or pipes.

D. Provide a minimum of 6 inches between suspended celling and cabling pathway.

2.4 ADJUSTABLE CABLE SUPPORTS

A. Description: Prefabricated adjustable strap cable supports for telecommunications cable.

B. Adjustable Cable Supports shall be installed at a maximum of 5-foot intervals to support and distribute the cable's weight.

C. Adjustable Cable Supports shall be installed to ensure horizontal pathways or cables do not rest directly on the ceiling panels, support channels, ceiling support wires, HVAC ducts or pipes.

D. Provide a minimum of 6 inches (150 mm) between suspended celling and cabling pathway.

2.5 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.
3. Refer to 26 0533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS for manufacturer.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

1. IMC: Comply with ANSI C80.6 and UL 1242.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040-inch, minimum.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:

a. Material: Steel or die cast.
b. Type: Setscrew or compression.

2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.6 NONMETALLIC CONDUITS AND FITTINGS

A. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Continuous HDPE: Comply with UL 651B.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway, approved for plenum or riser installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

2.8 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: J-HOOKS AND/OR Adjustable Cable Supports.
2. Exposed and Subject to Physical Damage: GRC. Pathway locations include the following:

a. Loading docks.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiums.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
4. Damp or Wet Locations: GRC.
5. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway and EMT OR J-Hooks AND/OR Adjustable Cable Supports.
6. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser- type, optical-fiber-cable pathway, and EMT.
7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: Riser-type, optical-fiber-cable pathway Riser-type, communications-cable pathway or EMT .
8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 1-inch trade size.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings. Seek prior approval from Architect or PSU before installing surface pathways.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. All pathways shall be installed in an orderly workmanlike manner. Pathway shall follow parallel to building lines where possible. Pathway systems shall be installed level and plumb.

C. All pathways shall be installed in the locations shown on drawings based on design phase coordination with other trades. Overhead cable pathways with J-Hooks and Adjustable Cable Supports shall be installed tight to walls, or in locations where occupant sight lines are obstructed.

D. Provide all components of the tray system (tray, supports, splices, fasteners, and accessories) from a single manufacturer. Cable tray shall be secured to the structural ceiling, building truss system, wall or floor using manufacturer's recommended supports and appropriate hardware as defined by local code or the authority having jurisdiction (AHJ).

E. When the pathway is overhead, cable tray shall be installed with a minimum clearance of 12 inches above the tray. Leave 12 inches in between the tray and ceiling/building truss structure. Multiple tiers of cable tray shall be installed with a minimum clearance of 12 inches in between the trays. When located above an acoustical drop ceiling, cable tray shall be installed a minimum of 3 inches above the drop ceiling tiles.

F. When installed under a raised floor, cable tray shall be installed with a minimum 3/4 inches clearance between the top of the tray and the bottom of the floor tiles or floor system stringers, whichever are lower in elevation. Maintain a 3-inch clearance between trays wherever trays cross over.

G. Cable tray shall be supported in accordance with ANSI/EIA/TIA-569 and NEMA VE-2 (2018). Support cable tray within 2 feet of every splice and intersection. Support intersections on all sides. Support cable tray on both sides of every change in elevation/direction. The weight of the load on the cable tray must not exceed the stated limits per span in the manufacturer's published load table. Use additional supports where needed.

H. Cable trays dedicated for communications cables shall be used to support and protect low voltage Divisions 27 cabling only. Under no circumstances shall line voltage electrical cabling be located within any tray used to route Divisions 27 cabling. Cable trays must not be placed to allow hangers or supports for ceiling grid, plumbing, electrical, or any other mechanical systems to pass through the trays.

I. Cable trays, cable basket, and hangers must be installed in such a manner that all installed cable can be routed to maintain TIA and BICSI standards for keeping the proper distances away from Electro Magnetic Interference (EMI) or Radio Frequency Interference (RFI) producing fixtures AC power

cables, motors, transformers, fluorescent lighting ballasts, and other EMI/RFI generating equipment. High voltage, high emissions equipment may require greater distances.

J. Cable trays shall be installed with a minimum clearance of 18 inches between the frame of the tray or basket on one side and any items in the immediate ceiling area and a minimum of 12” above.

K. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

L. Remove burrs and sharp edges from cable trays.

M. Fasten cable tray supports to building structure.

1) Place supports so that spans do not exceed seven (7) foot maximum spans.
2) Construct supports from channel members, threaded rods, and other accessories furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
3) Support cable tray assembly to prevent twisting from eccentric cable loading.
4) Locate and install supports according to NEMA VE 1.

N. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

O. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

P. Make changes in direction and elevation using standard transitions listed below.

1) Sweeping 90, Sweeping Tee

Q. Make cable tray connections using standard fittings.

R. Secure cable tray to each support with a minimum of one fastener. Follow the manufacturers’ recommended assembly, splice, and intersection-forming practices.

S. Use installation tools and practices recommended by the manufacturer to field fabricate cable tray intersections and changes in elevation. Use side-action bolt cutters with an offset head to cut cable tray.

T. Cable tray shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the tray and a minimum #6 grounding wire or as recommended by the AHJ. Follow UL Classified splicing methods recommended by the manufacturer or ground the tray per NEC requirements and verify bonds at splices and intersections between individual cable tray sections. Cable pathway should be electrically continuous through bonding and attached to the TGB.

U. The quantity of cables within the tray will not exceed a whole number value equal to 50% of the interior area of the tray divided by the cross-sectional area of the cable. Cable fill will not exceed the depth of the cable tray’s side rail 2 inches4 inches6 inches.

V. The combined weight of cables within the tray will not exceed stated load capacity in manufacturer’s specifications.

W. Separate different media type within the tray. Treat each type of media separately when determining cable fill limits.

X. When pathways for other utilities or building services are within 2 feet of the cable tray, cover the tray after cables are installed.

Y. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

Z. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

AA. Complete pathway installation before starting conductor installation.

BB. All communications pathways are to be independently supported. Suspending pathways from piping, HVAC ductwork, ceiling grids, etc. is not acceptable.

CC. Arrange stub-ups so curved portions of bends are not visible above finished slab.

DD. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

EE. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

FF. Support conduit within 12 inches of enclosures to which they are attached.

GG. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

HH. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

II. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

JJ. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

KK. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

LL. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

MM. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

NN. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12-inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

OO. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings or where prior approval has been obtained from Architect or PSU.
2. Install surface pathway with a minimum 2-inch radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48-inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

PP. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

QQ. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

RR. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

SS. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

TT. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes at 18-inches above finished floor, measured to center of box, unless indicated otherwise. Where installed in an existing building, match the height of existing electrical outlets.

UU. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

VV. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

WW. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

XX. Fasten Junction and pull boxes to or support from building structure. Do not support boxes by conduits.

YY. Set metal floor boxes level and flush with finished floor surface.

ZZ. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

B. Sleeve and sleeve seals shall comply with the wall rating of the wall requiring penetration.

3.4 FIRESTOPPING

A. All pathways shall be installed in the locations shown on drawings based on design phase coordination with other trades. Overhead cable pathways with J-Hooks and Adjustable Cable Supports shall be installed tight to walls, or in locations where occupant sight lines are obstructed.

END OF SECTION 270528

SECTION 321200 – EXISTING ASPHALT PAVEMENT REPLACEMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, equipment and materials as required to rehabilitate asphalt pavement, in accordance with the project drawings.

1.2 REFERENCE STANDARDS

B. ASTM D 136 Sieve Analysis of Fine and Coarse Aggregates

C. ASTM D 422 Method for Particle - Size Analysis of Soils

D. ASTM D 698 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregated Mixtures, Using 5.5-lb Rammer and 12 inch Drop

E. ASTM D 1556 Density of Soil by the Sand-Cone Method

F. ASTM D 1557 Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures, Using 10 lb. Rammer and 10 inch Drop

G. ASTM D 1633 Test Method for Compressive Strength of Molded Soil-Cement Cylinders

H. ASTM D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate

I. ASTM D 2487 Classification of Soils for Engineering Purposes

J. ASTM D 2922 Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

K. ASTM D 4254 Test Methods for Minimum Index Density of Soils and Calculative of Relative Density

L. OSHA - 1926.650-651 and other applicable sections.

1.3 SUBMITTALS

M. **Base and Subbase:** Submit sieve analysis, moisture density relationship test for both ASTM D698 and D1557, and sand equivalency. The sieve analysis and moisture density relationship tests must have been completed within 12 calendar months from the date of submittal.

N. **Pavement:** Superpave Hot Mix Asphalt: Submit job mix formula for proposed Mix Design. Prepare a submittal that includes:

1. adjustments made to the JMF that make it the C-JMF;
2. adjustments made to the C-JMF during production;
3. documentation supporting these adjustments.

4. Current Stockpile Quality Control testing that includes the following to confirm the material in stockpile is similar to the material used for the original mix design, including RAP:

   a. Sieve analysis on the stockpiles to be used, including crusher control charts;

5. Note: Previously used mix designs that are used during the calendar year of confirmation may omit Step 5 if the stockpiles consist of the crushed material, including RAP, from the original mix design. Previously used mix designs that more than one calendar year has elapsed from the time of confirmation must include Step 5.

6. JMF with a content of more than 30% recycle asphalt pavement (rap) will not be accepted.

7. Material Test Reports: For each paving material.

O. **Painted Pavement Markings:** Submit manufacturer's certification that paint and beads meet or exceed specified requirements.

1.4 QUALITY CONTROL

P. Testing Agency Qualifications: Qualified according to ASTM D3666 for testing indicated.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIAL REQUIREMENTS

Q. The following types of suitable materials are defined:

1. Aggregate Base (3/4" Road Mix, ¾" Crushed Aggregate): Material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base. The material shall meet the following gradation requirements:

Sieve Size	Percent Passing By Weight
1"	100
3/4"	90 - 100
No. 4	40 - 65
No. 8	30 - 50
No. 200	3 - 9

   a. The sand equivalent value shall be not less than 30, sand equivalent not required if less than 5% passing the No. 200 sieve

   b. The material shall have a Los Angeles Abrasion of 35% or less.

2. Aggregate Subbase (Pit Run, Uncrushed Aggregate): Material that can be compacted readily by watering and rolling to form a firm stable subbase. The material shall meet the following requirements:

Sieve Size	Percent Passing By Weight
4”	100
3”	90-100
No. 4	30-75
No. 200	0 – 15.0

a. The sand equivalent value shall be not less than 30, sand equivalent not required if less than 5% passing the No. 200 sieve.

b. The material shall have a Los Angeles Abrasion of 40% or less.

2.2 PLANT MIX PAVEMENT

R. General: Superpave hot mix asphalt shall conform to the 2018 Idaho Department of Transportation Standard Specifications for Highway Construction, Section 405, and current supplements.

1. Mixture Type: SP-3

2. Grade of Asphalt: PG 64-28

3. Aggregate Size: 1/2”

4. Anti-Stripping Additive: Provide anti-stripping additive if the immersion compression retained strength (ASTM T165) of the design mix is less than 70 percent of the dry compressive strength. Anti-stripping additive shall be added at the refinery at a rate of 0.5 to 1.0 percent of asphalt cement as determined by laboratory test.

5. Aggregates:

a. General: Use materials and gradations that have performed satisfactorily in previous installations.

b. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, or crushed gravel.

c. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

a) For plant mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

6. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

7. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 WATERBORNE PAVEMENT MARKINGS

S. Paint to be waterborne with volatile organic compound (VOC) less than 150 g/L.

T. Paint to conform to either the current Idaho Waterborne Traffic Line Paint Specifications or to Federal Specification TT-P-1952-D with the following modifications:

1. Viscosity: 80-95 K.U. per ASTM D 562.

2. Total Nonvolatile Solids: 75% minimum per ASTM D 2369.

3. Scrub Resistance: 1,000 cycles minimum per ASTM D 2486.

4. pH: 9.6 S.U. minimum per (ASTM E 70).

U. Paint Colors: Meet the Federal Test Standard 595 with color chip designations:

5. White: 37875.

6. Yellow: 33538.

7. Blue: OSHA Handicap Blue

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

V. Asphalt Removal & Repave Work: Remove existing asphalt pavement in such a manner that it is minimally invasive and destructive to the existing base course. Regrade and recompact the existing base to the match existing grades.

1. Compact surface in lifts no greater in depth than 6 inches. The compacted surface of the finished aggregate shall be hard, uniform, and smooth.

W. Soft Spots

2. Repair soft spots identified in accordance with the repair methodology outlined in Section 205 of the 2023 Idaho Transportation Department's Standard Specifications for Highway Construction.

3. Test soft spot repair materials to confirm a minimum compaction of 95 percent of maximum dry density.

4. Submit materials to be used in the repair to Engineer as submittal if the materials were not already included and reviewed as part of the project.

5. Document limits of soft spot prior to proceeding with soft spot repair work. If limits of soft spots change during course of repair alert the engineer immediately.

6. Proceed with paving only after unsatisfactory conditions have been corrected and accepted by the Engineer.

X. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Verify that subgrade is dry and in suitable condition to begin paving.

Y. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, plant mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

7. Allow tack coat to cure undisturbed before applying plant mix asphalt paving.

8. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.2 PATCHING

Z. Plant Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches minimum into adjacent sound pavement. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

AA. Patching: Fill excavated pavements with plant mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SUPERPAVE HOT MIX ASPHALT PAVING

BB. Do not place pavement on a wet or frozen surface or when weather or surface conditions will otherwise prevent the proper handling or finishing of the pavement placement.

CC. Air and Surface Temperature Limitations:

Compacted Thickness of Individual Courses	Top Course	Leveling and Courses Below the Top Course
Less than 1.5”	60°F	-
1.5” to 3”	50°F	40°F
Greater than 3”	40°F	40°F

DD. Asphalt concrete shall not be placed when the surface and atmospheric temperature is below 40 degrees F, if rain is imminent or expected before time required for adequate cure, or if subgrade is wet or excessively damp.

EE. Machine place Hot Mix Asphalt on prepared surface, spread uniformly, and strike off. Place Hot Mix Asphalt by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place Hot Mix Asphalt base course in number of lifts and thicknesses indicated.

2. Place Hot Mix Asphalt surface course in single lift.

3. Spread mix at minimum temperature of 250 deg F (121 deg C).

4. Begin applying Hot Mix Asphalt along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

FF. Place Hot Mix Asphalt in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

6. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

GG. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with plant mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

HH. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of Hot Mix Asphalt courses.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches

3. Offset transverse joints, in successive courses, a minimum of 24 inches

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method.

5. Compact joints as soon as Hot Mix Asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

II. General: Begin compaction as soon as placed plant mix paving will bear roller weight without excessive displacement. Compact plant mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Do not operate vibratory rollers in the vibratory mode when the internal mix temperature is less than 175 °F or when checking or cracking of the mat occurs at a higher temperature.

JJ. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

KK. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while plant mix asphalt is still hot enough to achieve specified density. Continue rolling until plant mix asphalt course has been uniformly compacted to the following density:

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

LL. Finish Rolling: Finish roll paved surfaces to remove roller marks while plant mix asphalt is still warm.

MM. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

NN. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, plant mix asphalt. Compact by rolling to specified density and surface smoothness.

OO. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

PP. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

QQ. Pavement Surface Grades: Grade paved areas to ensure drainage of new paved area maintains a 1.0% to 3.0% grade toward existing drainage areas.

1. Supplement base course with new base material as needed to repair failed or non-draining areas of the existing pavement area.

2. If drainage is not achievable with supplement of base material, and grading, alert the Engineer before paving.

RR. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

3. Surface Course: Plus 1/4 inch, no minus.

SS. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

4. Surface Course: 1/8 inch.

5. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

TT. Corrective Actions:

6. Grind the asphalt pavement to within the surface smoothness tolerance, if thickness permits in accordance with the above criteria.

7. All grinding shall be done parallel to centerline. Adjacent grinder passes within any single ground area shall be extended to produce a neat rectangular area having a uniform surface appearance. At transverse boundaries between ground and unground areas, smoothly feathered transitions shall be made.

8. The Contractor shall check the pavement for smoothness after grinding, in accordance with this specifications and shall make any additional corrections necessary to the pavement to achieve smoothness.

9. After grinding has been completed, the ground pavement surface shall receive a fog coat at a rate approved by the Engineer.

10. The cost of such grinding or milling, and all related work such as fog coat, disposal of milled material, traffic control, flagging, profiling, surface repair of ground or milled areas, and temporary pavement markings shall be at the Contractor’s expense.

11. If correction of the pavement as listed above will not produce satisfactory results as to smoothness, or will reduce pavement thicknesses and serviceability excessively, the pavement shall be removed and replaced or overlaid to correct the deficiency at no additional cost to the project.

3.7 FIELD QUALITY CONTROL & ACCEPTANCE

UU. Thickness: The Contractor shall extract core samples from the in-place compacted plant mix pavement. Thickness will be determined according to ASTM D 3549.

1. Take two samples minimum. Take one core samples for every 3,500 square feet, at least one sample every day.

2. Tolerance: Plus 1/4 inch (6 mm), no minus.

3. If more than 25% of pavement core samples fail to meet thickness requirements with a tolerance of 0-1/4” minus of the project requirements, or if more than 10% fail to meet thickness requirements with a thickness deficit greater than 1/4", corrective actions shall be taken at no additional cost to the Owner.

4. Corrective Actions:

   a. Install 1.5-inch asphalt overlay with same Job Mix Formula and Plant Mix Pavement, if grades allow, or

   b. Remove and replace pavement to specified thickness, grades, and smoothness.

   c. If allowed by the Engineer, adjust price for asphalt pavement that does not meet thickness requirements in accordance with the following pay factor (PF) reductions:

      a) If thickness is ≥ 100% of Required Thickness, PF = 1.0.

      b) If thickness is 1/4" less than the Require Thickness, PF = 0.80.

      c) If thickness is 1/2" less than the Require Thickness, subject to rejection, if allowed to remain in place, the PF will be 0.75.

5. Core Samples during Pavement Placement: If cores are taken during placement of pavement, fill core sample holes with hot mix asphalt.

6. Core Samples after Pavement Placement: If cores are taken after placement of pavement, fill core sample hole with 4,000 psi concrete. Prevent concrete from staining asphalt pavement by using a plastic sheet around the core hole while filling with concrete. Tap plastic sheet down.

VV. The relative density after compaction shall be 92-96 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear asphalt testing device shall be used for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

3.8 PAVEMENT MARKING APPLICATION

WW. Apply pavement marking in accordance with the project drawings. If pavement markings existing and are not called out in the plans notify the Engineer.

XX. Install using Airless spray-type marking equipment, compatible with waterborne paint, and capable of providing a uniform wet film thickness of 15 ± 2 mils.

YY. Pavement surface must be clean and thoroughly dry.

ZZ. Ambient air temperature must be above 50°F.

AAA. Paint stripes to be uniform and free of erratic waves.

BBB. Width and location of marking to be as designated in the drawings and be within a tolerance of 5%.

CCC. Paint stripes must not deviate from the intended alignment by more than 2 inches in 100 feet.

DDD. Apply paint in accordance with the manufacturer's recommendations.

EEE. Apply painted pavement markings (school crosswalk text, RR crossings, turn arrows, etc.) using an approved template.

FFF. Mix paint thoroughly prior to application.

GGG. Do not thin paint.

HHH. Apply paint at a rate of not more than 100 square feet/gallon.

III. All pavement markings to conform to the MUTCD.

JJJ. If paint is unagitated for a period greater than 15 minutes, thoroughly agitate until the mixture is homogeneous prior to continuance of application.

END OF SECTION 321200