PROJECT MANUAL

Charles Thompson Memorial Hall
Rehabilitation, HVAC Upgrade, and
Elevator Addition

1824 Marshall Avenue
Saint Paul, MN 55104

for

Charles Thompson Memorial Hall

90% MNHS Grant Submittal Milestone

April 29, 2020

COMPILED BY THE DESIGN PROFESSIONALS OF RECORD

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DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES (MMA)

060312 Historic Wood Repair
061053 Miscellaneous Rough Carpentry
062013 Exterior Finish Carpentry
062023 Interior Finish Carpentry
064400 Ornamental Woodwork

DIVISION 07 – THERMAL AND MOISTURE PROTECTION (MMA)

070150.19 Preparation for Reroofing
072100 Thermal Insulation
074229 Terracotta Rainscreen Cladding
075323 Ethylene-Propylene-Diene-Monomer Roofing
076200 Sheet Metal Flashing and Trim
077100 Roof Specialties
077200 Roof Accessories
078443 Joint Firestopping
079100 Preformed Joint Seals
079200 Joint Sealants

DIVISION 08 – OPENINGS (MMA)

080314 Historic Treatment of Wood Doors
080352 Historic Treatment of Wood Windows
081213 Hollow Metal Frames
081433 Stile and Rail Wood Doors
084213 Aluminum Framed Entrances
084413 Glazed Aluminum Curtain Walls
085113 Aluminum Windows
087100 Door Hardware
088300 Mirrors

DIVISION 09 – FINISHES (MMA)

090320 Historic Treatment of Plaster
092216 Non-Structural Metal Framing
092900 Gypsum Board
093013 Ceramic Tiling
095123 Acoustical Tile Ceilings
096513 Resilient Base and Accessories
096516 Linoleum Flooring
096813 Tile Carpeting
099113 Exterior Painting
099123 Interior Painting
099300 Staining and Transparent Finishes

DIVISION 10 – SPECIALTIES (MMA)

101419 Dimensional Letter Signage
102113 Toilet Compartments
102800 Toilet, Bath, and Laundry Accessories

DIVISION 14 – CONVEYING EQUIPMENT (EAG)

142123.16 Machine Room-less Electric Elevators

DIVISION 22 – PLUMBING (Hallberg)

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (Hallberg)

DIVISION 25 – INTEGRATED AUTOMATION (Hallberg)

DIVISION 26 – ELECTRICAL (Hallberg)

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY (Hallberg)

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.

B. Related Requirements:

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

1.2 PROJECT INFORMATION

A. Project Identification: Charles Thompson Memorial Hall Rehabilitation, HVAC Upgrade, and Addition.

1. Project Location: 1824 Marshall Avenue, St. Paul, MN 55104.

B. Owner: Charles Thompson Memorial Hall, 1824 Marshall Avenue, St. Paul, MN 55104

1. Owner's Representative: Herman Fuechtmann, 1824 Marshall Avenue, Saint Paul, MN 55104; hermanfuechty@gmail.com.

C. Architect: MacDonald & Mack Architects, Ltd., 400 South Fourth Street, Suite 712, Minneapolis, MN 55415.

1. Architect's Representative: Todd Grover. Email: toddg@mmarchltd.com

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Civil Engineering: Anderson Engineering of Minnesota 13605 First Avenue North, #100 Plymouth, MN 55441
   a. Erik Hedman; 763.412.4029; ehedman@ae-mn.com
2. Mechanical, Electrical, and Plumbing Engineering: Hallberg

a. Mechanical and Plumbing Engineering: Tom Stoutenburg; 651.748.4377; tstoutenburg@hallbergengineering.com
b. Electrical Engineering: Dave Quigley; 651.748.4346; dquigley@hallbergengineering.com

3. Structural Engineering: Mattson-Macdonald-Young
   a. Ken Green: 612.827.7825; keng@mattsonmacdonald.com
4. Elevator Consultants: Elevator Advisory Group
   a. Kathy Markwell, President, (952) 210-3319; kathy@elevatoradvisorygroup.com

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. The work includes general rehabilitation of the building, HVAC upgrades, construction of an addition to provide improved accessibility, and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: 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.

1.5 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated.

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

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Obtain Architect's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Architect's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for [drug] [and] [background] screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

1.3 PROCEDURES

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1 – Underpinning Foundation

1. Description: XX
2. Unit of Measurement: Linear Foot.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

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

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

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

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

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

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Replace Roof on Existing Fly Loft

1. Base Bid: The base bid includes no roof replacement.
2. Alternate: The contractor is to provide an alternate cost to replace the membrane roofing on the existing fly loft.

B. Alternate No. 2: Install storm water connection to City.

1. Base Bid: Storm water will be ejected on to site as described in documents.
2. Alternate: Storm water will be connected underground to the City storm water in the street.

C. Alternate No. 3: Install wood columns and balustrades on the north porch.

1. Base Bid: Install Chadsworth Polystone as detailed on the drawings.
2. Alternate: Install painted wood component system.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

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

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 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 form **acceptable to Architect**.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of 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 substitutions 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 as well as 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.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions 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.

1.4 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.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 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. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. <Double click to insert sustainable design text for requested substitution.>
c. Substitution request is fully documented and properly submitted.
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.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 **the Notice to Proceed**. Requests received after that time may be considered or rejected at discretion of Architect.

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

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. <Double click to insert sustainable design text for requested substitution.>
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.

k. 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 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 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**.

1. Work Change Proposal Requests issued by **Architect** are not instructions either to stop work in progress or to execute the proposed change.

1.3 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** after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

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

B. Contractor-Initiated Proposals: If latent or 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 Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

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

1.5 CONSTRUCTION CHANGE DIRECTIVE

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

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

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

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

1.6 WORK CHANGE DIRECTIVE

A. Work Change Directive: **Architect** may issue a Work Change Directive on **EJCDC Document C-940**. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SCHEDULE OF VALUES

A. 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 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.

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. Arrange schedule of values consistent with format of **AIA Document G703**.
2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of **five** percent of the Contract Sum.
3. 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.

4. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
6. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling **five** percent of the Contract Sum and subcontract amount.
8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.3 APPLICATIONS FOR PAYMENT

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

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the seventh **day** of the month. The period covered by each Application for Payment is one month, ending on the **last day of the month unless otherwise agreed to by both the Contractor and the Owner**.

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

D. Application for Payment Forms: Use **AIA Document G702 and AIA Document G703** as form for Applications for Payment.

E. 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.

F. 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.

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

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. 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.

H. 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. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire Owner's insurance.

I. 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.

J. 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.
5. AIA Document G706A.
6. AIA Document G707.
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

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 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. RFIs.
4. Project meetings.

B. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 INFORMATIONAL SUBMITTALS

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

1. Name, address, telephone number, and email address 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.

1.3 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. 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.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

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

    a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

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

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components 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. Review: Architect will review coordination drawings to confirm that, in general, 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 suitable modifications and resubmit.

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

1. File Preparation Format:

    a. Same digital data software program, version, and operating system as original Drawings.

2. File Submittal Format: Submit or post coordination drawing files using **format same as file preparation format**.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Contractor shall execute a data licensing agreement in the form of **Agreement form acceptable to Owner and Architect**.

1.5 REQUEST FOR INFORMATION (RFI)

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

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

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

1. Owner name.
2. Owner's Project number.
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
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.

C. RFI Forms: **AIA Document G716**.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow **seven** 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. The following Contractor-generated RFIs will be returned without action:

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

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 by Architect 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 Section 012600 "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 **five** days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log **weekly**. **Include the following:**

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

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

1.6 PROJECT MEETINGS

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

B. Preconstruction Conference: **Schedule and conduct**\ a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than **15** days after Notice to Proceed.

1. 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.
2. Agenda: Discuss items of significance that could affect progress, including the following:

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

3. 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 when required by other sections and when required for 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. Progress Meetings: **Conduct** progress meetings at **regular** intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

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

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 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.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

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

1. Working electronic copy of schedule file, where indicated.
2. PDF file.

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

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

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

D. Daily Construction Reports: Submit at weekly intervals.

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

1.4 COORDINATION

A. 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.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

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

B. Time Frame: Extend schedule from date established for commencement of the Work to date of final 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.

C. Activities: Treat each floor 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 Section 013300 "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. Commissioning Time: Include no fewer than 15 days for commissioning.
6. 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.
7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

D. 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. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Uninterruptible services.
c. Use-of-premises restrictions.
d. Provisions for future construction.
e. Seasonal variations.
f. Environmental control.

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 the Contract Time.

F. 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.

G. 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. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

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

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

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.

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

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

1.7 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. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
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. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

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

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

1. Submit photos electronically in a manner approved by the Architect. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description **in file metadata tag**:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.3 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of **12** megapixels, and at an image resolution of not less than 1920 x 1080 pixels. Use flash in low light levels or backlit conditions.

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

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with **date** and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

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

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by **Architect**.
1. Take **20** photographs to show existing conditions adjacent to property before starting the Work.
2. Take **20** photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

D. Periodic Construction Photographs: Take **20** photographs **weekly**. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take **20** photographs after date of Substantial Completion for submission as Project Record Documents. **Architect** will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

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. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, 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.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.

10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

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

1.5 SUBMITTAL PROCEDURES

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.

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. 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 7 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. Resubmittal Review: Allow 7 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form as initial submittal.

E. 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.

F. 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.

1.6 SUBMITTAL REQUIREMENTS

A. 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 unsuitable 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 that show 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 Shop Drawings, and before or concurrent with Samples.

B. 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

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.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

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

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
6. 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.

7. 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(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

8. 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 **two** Sample sets; remainder will be returned.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) 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.

D. 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:

E. 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.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit 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. Provide a notarized signature where indicated.
2. 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.
3. 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.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. 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.

H. Test and Research Reports:

1. 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 substrate preparation and primers required.
2. 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.

3. 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.
4. 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.
5. 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.
6. 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. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 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 insufficient 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 file**] [**and**] [**three**] <**Insert number**> 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.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals 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. Contractor's Approval: Indicate Contractor's approval for each submittal with **a uniform approval stamp**. Include 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.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required**, and return it**.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action**.**

B. 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.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

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

E. Architect will **discard** submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013591 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general protection and treatment procedures for designated historic spaces, areas, rooms, and surfaces in Project.

1.2 DEFINITIONS

A. Consolidate: To strengthen loose or deteriorated materials in place.

B. Design Reference Sample: A sample that represents Architect's prebid selection of work to be matched; it may be existing work or work specially produced for Project.

C. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

D. Historic: Spaces, areas, rooms, surfaces, materials, finishes, and overall appearance that are important to the successful **rehabilitation** as determined by Architect. Designated historic **spaces,** a**reas, rooms, and surfaces** are **indicated on Drawings**.

1. [**Restoration Zones**] [**Grade 1 Areas**] <**Insert designation**>: Areas of greatest architectural importance, integrity, and visibility; to be preserved and restored to the original, circa <**Insert date**>, design and finish as indicated on Drawings.
2. [**Renovation Zones**] [**Grade 2 Areas**] <**Insert designation**>: Areas of significant architectural importance, integrity, and visibility; to be preserved and restored consistent with the remaining historic fabric and to the extent indicated on Drawings.
3. [**Alteration Zones**] [**Grade 3 Areas**] <**Insert designation**>: Areas of slight architectural importance, integrity, and visibility; to leave any remaining original fabric untouched insofar as is consistent with accommodating modern uses for the building as indicated on Drawings.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.

H. Remove: To take down or detach a nonhistoric item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

I. Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

J. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

K. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

L. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

M. Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.

N. Retain: To keep existing items that are not to be removed or dismantled.

O. Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.

P. Salvage: To protect removed or dismantled items and deliver them to Owner[**ready for reuse**].

Q. Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.

R. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 PROJECT MEETINGS FOR HISTORIC TREATMENT

A. Preliminary Historic Treatment Conference: Before starting historic treatment work, **conduct** conference at **Project site**.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, installers whose work interfaces with or affects historic treatment shall be represented at the meeting.
2. Agenda: Discuss items of significance that could affect progress of historic treatment work, including review of the following:

    a. Fire-prevention plan.
    b. Governing regulations.
    c. Areas where existing construction is to remain and the required protection.
    d. Hauling routes.
    e. Sequence of historic treatment work operations.
    f. Storage, protection, and accounting for salvaged and specially fabricated items.
    g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.

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

B. Coordination Meetings: Conduct specifically for historic treatment work at rgular intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of historic treatment work. Include topics for discussion as appropriate to status of Project.
2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.4 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1.5 INFORMATIONAL SUBMITTALS

A. Historic Treatment Program: Submit 15 **days** before work begins.

B. Fire-Prevention Plan: Submit 15 days before work begins.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: An experienced firm regularly engaged in historic treatments similar in nature, materials, design, and extent to the work as specified in each Section.

1. Field Supervisor Qualifications: Full-time supervisors experienced in historic treatment work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on site when historic treatment work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond control of the specialist firm.

B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

C. Historic Treatment Program: Prepare a written plan for historic treatment for whole Project, including each phase or process and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of work. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project historic treatment program with specific requirements of programs required in other historic treatment Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

E. Safety and Health Standard: ANSI/ASSE A10.6.

1.7 STORAGE AND HANDLING OF HISTORIC MATERIALS

A. Salvaged Historic Materials:

1. Clean loose dirt and debris from salvaged historic items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label 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.

B. Historic Materials for Reinstallation:

1. Repair and clean historic items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.

D. Storage: Catalog and store historic items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Identify each item with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where historic treatment work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during historic treatment work.
5. Contain dust and debris generated by historic treatment work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.

B. Temporary Protection of Historic Materials:

1. Protect existing historic materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by historic treatment work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for historic treatment work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as stone or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from historic treatment work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

A. Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated. **Perform duties titled "Owner's Responsibility for Fire Protection."**
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

    a. If combustible material cannot be removed, provide fire blankets to cover such materials.

3. Prohibit smoking by all persons within Project work and staging areas.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of **open-flame or** welding or other high-heat equipment. Notify Owner **at least 72 hours** before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

    a. Train each fire watch in proper operation of fire-control equipment and alarms.
    b. Prohibit fire-watch personnel from other work that would distract from fire-watch duties.
    c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.

d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than **30 minutes** after conclusion of work **in each area** to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for type of fire risk in each work area. Ensure that nearby personnel and fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in historic treatment program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL HISTORIC TREATMENT

A. Have historic treatment work performed only by qualified historic treatment specialists.

B. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.

C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation **photographs**. Comply with requirements in Section 013233 "Photographic Documentation."

D. Perform **regular** inspections of Project site as the Work progresses to detect hazards resulting from historic treatment procedures.

E. Follow the procedures in subparagraphs below and procedures approved in historic treatment program unless otherwise indicated:

1. Retain as much existing material as possible; repair and consolidate rather than replace.
2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
3. Use reversible processes wherever possible.
4. Use historically accurate repair and replacement materials and techniques unless otherwise indicated.
5. Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation **photographs**. Comply with requirements in Section 013233 "Photographic Documentation."

F. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

G. Where missing features are indicated to be repaired or replaced, provide work with appearance based on accurate duplications rather than on conjecture, subject to approval of Architect.

H. Where work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.

I. Identify new and replacement materials and features with permanent marks hidden in the completed Work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

END OF SECTION 013591

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Testing and inspection 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 quality-control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described 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.

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

C. 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, assembly, 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).

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

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.

E. 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.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

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

I. 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.

J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 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.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements 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 direction before proceeding.

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

1.5 ACTION SUBMITTALS

A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 INFORMATIONAL SUBMITTALS

A. 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.

B. Permits, Licenses, and Certificates: For Owner's record, 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.

1.7 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, telephone number, and email address 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 inspection.
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 Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
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. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.8 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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, applying, 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 inspection 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.

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

J. 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 and test assemblies; 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.

K. 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 of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.

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

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

L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.9 QUALITY CONTROL

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

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

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

1. Engage a qualified testing agency to perform quality-control services.

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

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

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

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 locations 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 duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including

service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Associated Contractor Services: Cooperate with agencies and representatives 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 inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

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

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

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector 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 reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, 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 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, 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.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

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- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. 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.
3. Indicate methods to be used to avoid trapping water in finished work.

1.4 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.

1.5 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 TEMPORARY FACILITIES

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

B. 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.

2.2 EQUIPMENT

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

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

3.2 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.

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.

C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

3.3 TEMPORARY UTILITY INSTALLATION

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

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, eyewash 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.

C. Temporary 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.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

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

E. 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.

F. Telephone Service: Provide key personnel with mobile telephones and distribute numbers to all interested parties.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:
   1. Utilize designated area within existing building for temporary field offices.
   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. 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.

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

   1. Identification Signs: Provide Project identification signs as indicated on Drawings.
   2. 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.

   3. Maintain and touch up signs so they are legible at all times.

D. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

F. 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.

G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.5 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.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

C. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

D. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

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

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

F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by **Owner and tenants** from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Provide walk-off mats at each entrance through temporary partition.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.

3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

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

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

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

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

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

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 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.

1.2 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. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, 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 single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section,

provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 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.

1.4 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.

1.5 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

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 meeting 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. Sole 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.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole 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.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with

requirements. Comparable products or substitutions for Contractor's convenience **will** be considered.

a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: 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.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will** be considered **unless otherwise indicated**.

6. Non-Limited List of Manufacturers: 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.

7. 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 may additionally 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.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "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 a 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.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of 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 may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
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.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

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

C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 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. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:
1. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

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, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements 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.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. 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. Use materials that are not considered hazardous.

C. 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 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, gas service piping, 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** that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with 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, in relation to the property survey and existing benchmarks and existing conditions. 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. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. 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.
4. Maintain minimum headroom clearance of **96 inches (2440 mm)** in occupied spaces and **90 inches (2300 mm)** in unoccupied spaces, unless otherwise indicated on Drawings.

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 satisfactory results as judged by Architect. 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 of type expected for Project.

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: Select tools or equipment that minimize production of excessive 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 portions of the 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 with manufacturer.

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, as judged by Architect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.5 CUTTING AND PATCHING

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

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

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

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to **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. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

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

4. Excavating and Backfilling: Comply with requirements in applicable 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, as judged by Architect. 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 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, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. 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 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. 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 (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

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: 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. Comply with waste disposal requirements in **Section 015000 "Temporary Facilities and Controls."**

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 ensure 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. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

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

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

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

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

3.8 PROTECTION AND REPAIR 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. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

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

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 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.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional 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 to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

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

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

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.4 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, 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.
5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. 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 utility services.
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.
10. Touch up paint 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.

1.5 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. 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.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance 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 a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS

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

1. Organize list of spaces in sequential order, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File: Architect will return annotated file.

1.7 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, 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 Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit **by email to Architect**.

D. Warranties in Paper Form:

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 (215-by-280-mm) paper.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

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. 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 of rubbish, waste material, litter, and other foreign substances.
b. 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.

c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
e. Vacuum and mop concrete.
f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
h. Remove labels that are not permanent.
i. Wipe surfaces of mechanical and electrical equipment**, elevator equipment,** and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
l. Clean ducts, blowers, and coils **if units were operated without filters during construction or that display contamination with particulate matter on inspection**.

    1) Clean HVAC system in compliance with **NADCA ACR.**

m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
n. Clean strainers.
o. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in **Section 015000 "Temporary Facilities and Controls."**

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

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

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved 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 operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

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

1. Submit **by email to Architect**. Enable reviewer comments on draft submittals.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 10 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.

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

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. 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: Bookmark 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.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

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

B. Title Page: Include the following information:

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

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

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

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

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

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

C. 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.

D. 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.

E. 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.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

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

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.

4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. 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.

D. 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.

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

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

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

B. 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 warranties and bonds, as described below.

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

1. Standard maintenance instructions and bulletins; 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.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

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

1. Include procedures to follow and required notifications for warranty claims.

H. 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.

1.8 PRODUCT MAINTENANCE MANUALS

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

B. 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.

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

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

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

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

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

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

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 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.

1.2 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 PDF electronic files of scanned record prints and **one** set of file 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 file prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit **annotated PDF electronic files and** 1**paper copies** of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit **annotated PDF electronic files and directories** of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.3 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. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or **Construction** Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

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

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file **with comment function enabled**.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

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

1.4 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. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders**, Record Product Data,** and Record Drawings where applicable.

B. Format: Submit record specifications as **annotated PDF electronic file**.

1.5 RECORD PRODUCT DATA

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

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

C. Format: Submit Record Product Data as **annotated PDF electronic file**.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

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

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 INFORMATIONAL SUBMITTALS

1.3 QUALITY ASSURANCE

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

1.4 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 instructors, including providing notification of dates, times, length of instruction time, and course content.

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

1.5 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.

B. Training Modules: Develop a including 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. Systems and equipment operation manuals.
c. Systems and equipment maintenance manuals.
d. Product maintenance manuals.
e. Project Record Documents.
f. Identification systems.
g. Warranties and bonds.
h. 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.

1.6 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."

B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

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

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

C. 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.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings **and site improvements**.
2. Disconnecting, capping or sealing, and **removing** site utilities.
3. Salvaging items for reuse by Owner.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at **Project site**.

1.4 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property**, for dust control and noise control**. Indicate proposed locations and construction of barriers.

B. Schedule of building demolition activities with starting and ending dates for each activity.

C. Predemolition photographs or video.

1.5 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.6 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
1. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

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

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work. **Lead-based paint?**

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. On-site storage or sale of removed items or materials is not permitted.

E. Arrange demolition schedule so as not to interfere with Operations **of adjacent occupied buildings**.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

Retain this article for backfilling voids that result from demolition operations in below-grade areas. Coordinate with requirements in Part 3.

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. **Perform** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
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 storage area [**designated by Owner**] [**indicated on Drawings**].
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
1. Arrange to shut off utilities with utility companies.
2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of **24 inches (610 mm)** below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
4. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION

A. General: Demolish indicated buildings **and site improvements** completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least two hours after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

C. Explosives: Use of explosives is not permitted.

D. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

E. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

F. Salvage: Items to be removed and salvaged are indicated [**on Drawings.**] [**below:**]

1. <**Insert items to be salvaged**>.

G. **Demolish** foundation walls and other below-grade construction **that are within footprint of new construction and extending 5 feet (1.5 m) outside footprint indicated for new construction**.

1. Remove below-grade construction, including basements, foundation walls, and footings, **to at least 6 inches (150 mm) below grade**.

H. Existing Utilities: **Demolish** existing utilities and below-grade utility structures that are within **5 feet (1.5 m)** outside footprint indicated for new construction. Abandon utilities outside this area.

I. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with **satisfactory soil materials** according to backfill requirements in Section 312000 "Earth Moving."

J. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

K. Promptly repair damage to adjacent buildings caused by demolition operations.

3.6 CLEANING

A. Remove demolition waste materials from Project site **and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.**

B. Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for dust control. Indicate proposed locations and construction of barriers.

C. Schedule of selective demolition activities with starting and ending dates for each activity.

D. Predemolition photographs or video.

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

1.5 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

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

1. Before selective demolition, Owner will remove the following items:

a. All furniture, shelving, storage in the lower level of the ramp, and items not attached or built-into the existing building.

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

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

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off utilities with utility companies.
   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 plumbing, HVAC systems, equipment, and components indicated on Drawings to be removed.

      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
      d. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

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. 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 portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction, and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

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. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. 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

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Removal of deteriorated concrete and reinforcement and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer sealers.

1.2 UNIT PRICES

A. Unit prices include the cost of preparing existing construction to receive the work indicated.

B. Concrete Removal and Replacement or Patching: Work will be paid for by the cubic foot computed on the basis of rectangular solid shapes approximating the actual shape of concrete removed and replaced with average depths, widths, and lengths, measured to the nearest inch.

1. Reinforcing bar replacement will be paid for separately by the pound of replacement steel with welded and mechanical splices paid for by the unit.

C. Epoxy Crack Injection: Work will be paid for by the linear foot of crack injected.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For installers.

1. For products required to be installed by workers approved by product manufacturers, include letters of acceptance by product manufacturers certifying that installers are approved to apply their products.

C. Material Certificates: For each type of product indicated, signed by manufacturers.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer that employs workers trained and approved by manufacturer to apply concrete patching and rebuilding materials and epoxy crack injection materials.

B. Mockups: Build mockups for concrete removal and patching, epoxy crack injection, and polymer sealers to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 BONDING AGENTS

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Euclid Chemical Company (The); Corr-Bond.
b. Kaufman Products, Inc; Surepoxy HM EPL.
c. Sika Corporation; Armatec 110 EpoCem.
d. Sonneborn, Div. of ChemRex; Sonoprep.
e. Sto Corp., Concrete Restoration Division; Sto Bonding and Anti-Corrosion Agent.
f. Tamms Industries, Inc.; Duralprep A.C.

B. Epoxy Bonding Agent: ASTM C 881/C 881M, Type II.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; Poly-Epoxy Bonding #100.
b. ChemCo Systems; CCS Bonder Liquid, LWL or SWL.
c. Kaufman Products, Inc.; SurePoxy HM EPL.
d. Meadows, W. R., Inc.; Sealtight Rezi-Weld 1000.
e. Sika Corporation; Sikadur 32, Hi-Mod; Sikadur 32.
f. Sonneborn, Div. of ChemRex; Epogel or Epogrip.

2. Thin Film Open Time: Not less than two hours.

C. Latex Bonding Agent: ASTM C 1059, Type II at exterior locations and where indicated, Type I at other locations.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Latex Bonding Agent, Type I:

1) Euclid Chemical Company (The); Euco Weld.
2) Kaufman Products, Inc.; Sureweld.

3) Meadows, W. R. Inc.; Intralok.
4) Sika Corporation; Sikalatex.
5) US MIX Products Company; US Spec Bondcoat.

b. Latex Bonding Agent, Type II:

1) Dayton Superior Corporation; Day-Chem Ad Bond (J-40).
2) Euclid Chemical Company (The); Flex-Con.
3) Kaufman Products, Inc.; Surebond.
4) Meadows, W. R. Inc.; Sealtight Acry-Lok.
5) Sonneborn, Div. of ChemRex; Acrylic Additive.
6) US MIX Products Company; US Spec Acrylcoat.

2.2 PATCHING MORTAR

A. Patching Mortar, General:

1. Unless otherwise indicated, use any of the products specified in this Article.
2. Overhead Patching Mortar: For overhead repairs, use patching mortar recommended by manufacturer for overhead use and as specified in this Article.
3. Coarse Aggregate for Adding to Patching Mortar: Washed aggregate complying with ASTM C 33, Size No. 8, Class 5S. Add only as permitted by patching mortar manufacturer.

B. Cementitious Patching Mortar: Packaged, dry mix complying with ASTM C 928.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cementitious Patching Mortar:

1) Kaufman Products, Inc.; Hicap.
2) MBT Protection and Repair, Div. of ChemRex; Emaco S88 CI.
3) Sika Corporation; Sikarepair 223.
4) Sonneborn, Div. of ChemRex; Deep Pour Mortar.
5) Sto Corp., Concrete Restoration Division; Sto Full-Depth Repair Mortar.
6) ThoRoc, Div. of ChemRex; LA Repair Mortar.

2.3 CONCRETE

A. Concrete Materials and Admixtures: Comply with Division 03 Section “Miscellaneous Cast-in-Place Concrete."

B. Steel and Fiber Reinforcement and Reinforcement Accessories: Comply with Division 03 Section "Miscellaneous Cast-in-Place Concrete."

C. Form-Facing Materials: Comply with Division 03 Section "Miscellaneous Cast-in-Place Concrete."

2.4 MISCELLANEOUS MATERIALS

A. Epoxy Joint Filler: 2-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 per ASTM D 2240.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; Groove & Crack Filler #250.
b. ChemCo Systems; CCS Grout, Control Joint, or Control Joint - HB.
c. Kaufman Products, Inc.; Surepoxy Flexijoint.
d. MBT Protection and Repair, Div. of ChemRex; Masterfill 300i.
e. Meadows, W. R., Inc.; Sealtight Rezi-Weld Flex.
f. Sika Corporation; Sikadur 51 NS or Sikadur 51 SL.

B. Polyurea Joint Filler: 2-component, semirigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 per ASTM D 2240.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. ASTC Polymers; Penetron 3003.
b. Dayton Superior Corporation; Joint Saver II.
c. Euclid Chemical Company (The); Euco Qwikjoint 200.
d. MBT Protection and Repair, Div. of ChemRex; Masterfill 400 CT.
e. Sonneborn, Div. of ChemRex; Sonolastic TF-100.

C. Epoxy Crack Injection Adhesive: ASTM C 881/C 881M, Type I, solvent free.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. ChemCo Systems; CCS Grout, Standard.
b. Dayton Superior Corporation; Sure-Inject (J-56).
c. MBT Protection and Repair, Div. of ChemRex; Concresive Standard LVI.
d. Meadows, W. R., Inc.; Sealtight Rezi-Weld LV.
e. Sika Corporation; Sikadur 35, Hi-Mod LV.
f. Sonneborn, Div. of ChemRex; Epofil.
g. Tamms Industries, Inc.; Duralcrete LV.
h. US MIX Products Company; US Spec Maxi - Bond 500LV.

D. Capping Adhesive: Product manufactured for use with crack injection adhesive by same manufacturer.

E. Corrosion-Inhibiting Treatment Materials: Water-based solution of alkaline corrosion-inhibiting chemicals that penetrates concrete by diffusion and forms a protective film on steel reinforcement.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cortec Corporation; MCI 2020.
b. Degussa Corporation; Protectosil CIT.
c. Fox industries, Inc.; FX-361 Migratory Corrosion Inhibitor.
d. Sika Corporation; Sika Ferrogard 903.
e. Sonneborn, Div. of ChemRex; Corrosion Inhibitor.

F. Polymer Sealer: Low-viscosity epoxy penetrating sealer recommended by manufacturer for application to exterior concrete traffic surfaces.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Epoxy Sealers:

1) ChemCo Systems; CCS Coating, Epoxy Healer Sealer.
2) Euclid Chemical Company (The); Euco #512 Epoxy Sealer.
3) Fox Industries, Inc.; FX-452 Epoxy Penetrating Sealer.
4) Kaufman Products, Inc.; SurePoxy Penetrating Sealer.
5) MBT Protection and Repair, Div. of ChemRex; Masterseal GP.
6) Thermal-Chem; Hairline Crack Sealer, Product 207.
7) Unitex; Pro-Seal HS.
8) US MIX Products Company; US Spec Eposeal LVS.

2.5 MIXES

A. Mix products, in clean containers, according to manufacturer's written instructions.

1. Add clean silica sand and coarse aggregates to products only as recommended by manufacturer.
2. Do not add water, thinners, or additives unless recommended by manufacturer.
3. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
4. Do not mix more materials than can be used within recommended open time. Discard materials that have begun to set.

B. Dry-Pack Mortar: Mix with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

C. Concrete: Comply with Division 03 Section "Miscellaneous Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb, unless otherwise indicated.

C. Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer, using depth of cover measurements, and verify depth of cover in removal areas using pachometer.

3.2 PREPARATION

A. Protect people, motor vehicles, equipment, surrounding construction, Project site, plants, and surrounding buildings from injury resulting from concrete rehabilitation work.

1. Neutralize and collect alkaline and acid wastes according to requirements of authorities having jurisdiction, and dispose of by legal means off Owner's property.
2. Dispose of runoff from wet operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

B. Shoring: Install temporary supports before beginning concrete removal.

C. Concrete Removal:

1. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch (13 mm). Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.
2. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
3. Remove additional concrete, if necessary, to provide a depth of removal of at least[1/2 inch (13 mm) over entire removal area.
4. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least a 3/4-inch (19-mm) clearance around bar.
5. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.
6. Provide fractured aggregate surfaces with a profile of at least 1/8 inch (3 mm) that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level, unless otherwise directed.
7. Thoroughly clean removal areas of loose concrete, dust, and debris.

D. Reinforcing Bar Preparation: Remove loose and flaking rust from reinforcing bars by abrasive blast cleaning, needle scaling, or wire brushing until only tightly bonded light rust remains.

1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in 2 or more adjacent bars, cut bars and remove and replace. Remove additional concrete as necessary to provide at least 3/4-inch (19-mm) clearance at existing and replacement bars. Splice replacement bars to existing bars according to ACI 318 (ACI 318M), by lapping, welding, or using mechanical couplings.

E. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than 1 inch (25 mm) deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.

F. Surface Preparation for Corrosion-Inhibiting Treatment: Clean concrete by low-pressure water cleaning and detergent scrubbing to remove dirt, oils, films, and other materials detrimental to treatment application. Allow surface to dry before applying corrosion-inhibiting treatment.

G. Surface Preparation for Sealers: Clean concrete by low-pressure water cleaning anddetergent scrubbing to remove dirt, oils, films, and other materials detrimental to sealer application.

H. Surface Preparation for Sealers: Acid etch surface of concrete to produce a surface profile matching CSP 1 per ICRI 03732. Prepare surface for acid etching by detergent scrubbing to remove oils and films that may prevent acid penetration.

1. Remove excess acid solution, reaction products, and debris by squeegeeing or vacuuming.
2. Scrub surface with an alkaline detergent, rinse, and squeegee or vacuum.
3. Check acidity of surface with pH test paper and continue rinsing until pH is acceptable.
4. When pH is acceptable and surface is clean, vacuum dry.

3.3 APPLICATION

A. General: Comply with manufacturer's written instructions and recommendations for application of products, including surface preparation.

B. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars by stiff brush or hopper spray according to manufacturer's written instructions. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar or concrete.

C. Epoxy Bonding Agent: Apply to reinforcing bars and concrete by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Apply patching mortar or concrete while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.

D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface according to manufacturer's written instructions. Apply patching mortar or concrete while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar or concrete.

E. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar or concrete.

F. Patching Mortar: Unless otherwise recommended by manufacturer, apply as follows:

1. Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar into substrate, filling pores and voids.
2. Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always

troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

3. For vertical patching, place material in lifts of not more than 2 inches (50 mm) nor less than 1/4 inch (6 mm). Do not feather edge.
4. For overhead patching, place material in lifts of not more than 1-1/2 inches (38 mm) nor less than 1/4 inch (6 mm). Do not feather edge.
5. After each lift is placed, consolidate material and screed surface.
6. Where multiple lifts are used, score surface of lifts to provide a rough surface for application of subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
7. Allow surfaces of lifts that are to remain exposed to become firm and then finish to a smooth surface with a wood or sponge float.
8. Wet-cure cementitious patching materials, including polymer-modified, cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

G. Dry-Pack Mortar: Use for deep cavities. Unless otherwise recommended by manufacturer, apply as follows:

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.
3. Place dry-pack mortar into cavity by hand, and compact into place with a hardwood drive stick and mallet or hammer. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
4. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.
5. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

H. Concrete: Place according to Division 03 Section "Miscellaneous Cast-in-Place Concrete." and as follows:

1. Apply epoxy bonding agent to reinforcement and concrete substrate.
2. Apply latex bonding agent to concrete substrate.
3. Use vibrators to consolidate concrete as it is placed.
4. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.
5. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
6. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

I. Joint Filler: Install in nonmoving floor joints where indicated.

1. Install filler to a depth of at least 1 inch (25 mm). Use fine silica sand no more than 1/4 inch (6 mm) deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
2. Install filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

J. Epoxy Crack Injection: Comply with manufacturer's written instructions and the following:

1. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond, and clean cracks with oil-free compressed air or low-pressure water to remove loose particles.
2. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.
3. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch (6 mm) thick by 1 inch (25 mm) wider than crack.
4. Inject cracks wider than 0.003 inch (0.075 mm) to a depth of 8 inches (200 mm) or to a width of less than 0.003 inch (0.075 mm), whichever is less.
5. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.
6. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

K. Corrosion-Inhibiting Treatment: Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment by high-pressure washing before patching treated concrete.

L. Polymer Sealer: Apply by brush, roller, or airless spray at manufacturer's recommended application rate.

1. Apply to traffic-bearing surfaces, including parking areas and walks.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to sample materials and perform tests as follows:

1. Patching Mortar, Packaged Mixes: Eight randomly selected samples tested according to ASTM C 928.
2. Concrete: As specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."
3. Joint Filler: Core drilled samples to verify proper installation.

    a. Testing Frequency: One sample for each 100 feet (30 m) of joint filled.
    b. Where samples are taken, fill holes with joint filler.

4. Epoxy Crack Injection: Core drilled samples to verify proper installation.

    a. Testing Frequency: 1 sample for each 100 feet (30 m) of crack injected.
    b. Where samples are taken, fill holes with epoxy mortar.

END OF SECTION 030130

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

D. Formwork Shop Drawings.

E. Placement schedule.

F. Samples: For each of the following materials:

1. Form-facing panels.
2. Form ties.
3. Form liners.
4. Exposed aggregates.
5. Coarse- and fine-aggregate gradations.
6. Chamfers and rustications.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

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.

C. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.

D. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.6 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1.

1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1.

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 (ACI 301M).
2. ACI 117 (ACI 117M).

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. Must match adjacent concrete finishes.

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. Must match adjacent concrete surfaces.

C. Form-Facing Panels for As-Cast and Exposed-Aggregate Finishes to match existing surfaces: Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

D. Form Liners: Units of face design, texture, arrangement, and configuration matching adjacent surfaces and finishes. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

2.3 STEEL REINFORCEMENT

A. See structural drawings for specific requirements.

2.4 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, [Type I, gray.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.

1. Match aggregates of adjacent, existing concrete.

C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. Chemical Admixtures: Do not use unless submitted and approved by Architect prior to commencement of work.

E. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Color: As selected by Architect from manufacturer's full range.

F. Water: ASTM C 94/C 94M and potable.

2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

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. Barrier-Bac; Inteplast Group, Ltd.
    b. Fortifiber Building Systems Group.
    c. ISI Building Products.
    d. Poly-America, L.P.
    e. Raven Industries, Inc.
    f. Reef Industries, Inc.
    g. Stego Industries, LLC.
    h. Tex-Trude, LP.
    i. W.R. Meadows, Inc.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

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. BASF Corporation.
    b. Kaufman Products, Inc.
    c. Lambert Corporation.
    d. Laticrete International, Inc.
    e. Metalcrete Industries.
    f. Nox-Crete Products Group.
    g. Sika Corporation.
    h. SpecChem, LLC.
    i. TK Products.
    j. Vexcon Chemicals Inc.
    k. W.R. Meadows, Inc.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Do not use on exposed concrete to match adjacent concrete on retaining walls, waffle slab, columns, or exposed concrete surfaces intended to remain exposed and concrete patch is to match existing.

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. BASF Corporation.
b. ChemMasters, Inc.
c. Dayton Superior.
d. Euclid Chemical Company (The); an RPM company.
e. Vexcon Chemicals Inc.

F. ASTM C 309, Type 1, Class B, nondissipating[, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

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 (ACI 301M).

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Normal-Weight Concrete:

1. Minimum Compressive Strength: As indicated at 28 days.
2. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m).

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/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads. Formwork should match existing concrete surfacing.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M). Formwork should match existing concrete surfacing.

C. Chamfer to match exterior corners and edges of permanently exposed concrete.

3.2 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 (150 mm) and seal with manufacturer's recommended tape.

3.3 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.

3.4 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.

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 quarter of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

3.6 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 and to receive special finish.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. 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.

3.7 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

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. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm).

C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 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 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. 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.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial

application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 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.

3.11 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.

END OF SECTION 033000

SECTION 040120 - MAINTENANCE OF UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes maintenance of unit masonry consisting of **brick** clay masonry restoration and cleaning as follows:

1. Repairing unit masonry, including replacing units.
2. Repointing joints.
3. Preliminary cleaning, including removing plant growth.
4. Cleaning exposed unit masonry surfaces.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray: **100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)**

B. Medium-Pressure Spray: **400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)**

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Test bricks and mortar using the Russack System as described in “Preservation Brief #2” from the National Park Service. Perform absorption tests of bricks and mortar using RILEM tubes in conformance with RILEM Test Method II.4. Prepare written reports of both sets of tests and submit to Architect and Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.

1.6 QUALITY ASSURANCE

A. Restoration Specialist Qualifications: Engage an experienced masonry restoration and cleaning firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry is not sufficient experience for masonry restoration work.

1. At Contractor's option, work may be divided between two specialist firms: one for cleaning work and one for repair work.
2. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that clay masonry restoration and cleaning work is in progress.
3. Restoration Worker Qualifications: Persons who are experienced in restoration work of types they will be performing.

B. Terra Cotta Manufacturer Qualifications: A firm regularly engaged in manufacturing custom architectural terra cotta units for building restoration purposes, of same type and of similar size, complexity, and tolerances as those required for the Work.

C. Mockups: Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than 2 adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement:

1) **Four** brick units replaced.

b. Patching: Three small holes at least 1 inch (25 mm) in diameter for each type of masonry material indicated to be patched, so as to leave no evidence of repair.

2. Repointing: Rake out joints in 2 separate areas **, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide at locations selected by Architect** for each type of repointing required, and repoint one of the areas.
3. Cleaning: Clean an area **approximately 25 sq. ft. (2.3 sq. m)** for each type of masonry and surface condition.

D. Preinstallation Conference: Conduct conference at **Project site**.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick: Provide face brick, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.

1. Provide units with physical properties, colors, color variation within units, surface texture, size, and shape to match existing brickwork.

a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

B. Building Brick: Provide building brick complying with ASTM C 62, Grade SW where in contact with earth, Grade SW, MW, or NW for concealed backup; and of same vertical dimension as face brick, for masonry work concealed from view.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, white **or gray or both** where required for color matching of exposed mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Sand: ASTM C 144 unless otherwise indicated.

1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
2. For pointing mortar, provide sand with rounded edges.
3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

E. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Masonry Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry.

1. Products: Subject to compliance with requirements, **provide one of the following**:

a. Cathedral Stone Products, Inc.; Jahn M100 Terra Cotta and Brick Repair Mortar.
b. Edison Coatings, Inc.; Custom System 45.

2. Use formulation that is vapor- and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than the masonry units being repaired, and develops high bond strength to all types of masonry.
3. Formulate patching compound used for patching **brick** in colors and textures to match each masonry unit being patched.

2.4 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Mild Acidic Cleaner: Manufacturer's standard mildly acidic cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

1. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:

a. ABR Products, Inc.; X-190 Limestone & Concrete Cleaner.
b. Diedrich Technologies Inc.; Envirorestore 100.
c. Dominion Restoration Products, Inc.; DR-60 Stone and Masonry Cleaner.
d. PROSOCO; Enviro Klean BioWash.

2.5 ACCESSORY MATERIALS

A. Terra Cotta Anchors: Type and size indicated or, if not indicated, to match existing anchors in size and type. Fabricate anchors from **Type 304** stainless steel.

B. Setting Buttons: Resilient plastic buttons, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units without intruding into required depths of pointing materials.

2.6 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Brick: [**1 part portland cement, 2 parts lime, and 6 parts sand**] [**1 part portland cement, 6 parts lime, and 12 parts sand**] <**Insert required proportions**>.

   a. Add mortar pigments to produce mortar colors required.

2. Rebuilding (Setting) Mortar: Same as pointing mortar[**except mortar pigments are not required**].
3. Rebuilding (Setting) Mortar: [**1 part portland cement, 2 parts lime, and 6 parts sand**] [**1 part portland cement, 6 parts lime, and 12 parts sand**] <**Insert proportions**>.
4. Rebuilding (Setting) Mortar: Comply with ASTM C 270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime.

2.7 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

B. Mild Acidic Cleaner Solution for Brick: Dilute with water to concentration demonstrated by testing that does not etch or otherwise damage brick surface, but not greater than that recommended by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Keep wall wet below area being cleaned to prevent streaking from runoff.

3.2 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

D. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.

E. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Replace removed damaged brick with other removed brick in good quality, where possible, or with new brick matching existing brick, including size. Do not use broken units unless they can be cut to usable size.

G. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

H. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.3 MASONRY UNIT PATCHING

A. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1/4 inch (6 mm) thick, but not less than recommended by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of masonry unit.
3. Mix patching compound in individual batches to match each unit being patched.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.4 CLEANING MASONRY, GENERAL

A. Proceed with cleaning in an orderly manner; work from **bottom to top** of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.

B. Use only those cleaning methods indicated for each masonry material and location.

1. Do not use wire brushes or brushes that are not resistant to chemical cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

    a. Equip units with pressure gages.

3. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip.
4. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
5. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

D. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface of masonry and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

E. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical-cleaner manufacturer's written instructions; use brush **or spray** applicationDo not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.

F. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.5 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil and debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to cleaning methods being used. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of material from surface of masonry with a sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without prewetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.6 CLEANING MASONRY

A. Detergent Cleaning:

1. Wet masonry with **cold** water applied by low-pressure spray.
2. Scrub masonry with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar

joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that masonry surface remains wet.

3. Rinse with **cold** water applied by **medium**-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet masonry with **cold** water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush .
3. Scrub masonry with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that masonry surface remains wet.
4. Rinse with **cold** water applied by **medium**-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

C. **Mild Acidic** Chemical Cleaning:

1. Wet masonry with cold water applied by low-pressure spray.
2. Apply cleaner to masonry by brush **or low-pressure spray**. Let cleaner remain on surface for period indicated below:

    a. As recommended by chemical-cleaner manufacturer.
    b. As established by mockup.

3. Rinse with cold water applied by **low**-pressure spray to remove chemicals and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.7 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints where mortar is missing or where they contain holes.
3. Cracked joints where cracks can be penetrated at least 1/4 inch (6 mm) by a knife blade 0.027 inch (0.7 mm) thick.
4. Cracked joints where cracks are **1/8 inch (3 mm)** or more in width and of any depth.
5. Joints where they sound hollow when tapped by metal object.
6. Joints where they are worn back 1/4 inch (6 mm) or more from surface.
7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
8. Joints where they have been filled with substances other than mortar.
9. Joints indicated as sealant-filled joints.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of **2-1/2 times joint width**, but not less than 1/2 inch (13 mm) or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.
    a. Remove mortar using methods determined by mockups
    b. Do not modify mortar removal method without written permission from the Architect

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120

SECTION 040140 - MAINTENANCE OF STONE ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes maintenance of stone assemblies consisting of stone restoration and cleaning as follows:

1. Repairing stone masonry, including replacing whole units.
2. Repointing joints.
3. Preliminary cleaning, including removing plant growth.
4. Cleaning exposed stone surfaces.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray: **100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)**.

B. Medium-Pressure Spray: **400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)**

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Test stones and mortar using the Russack System as described in “Preservation Brief #2” from the National Park Service. Perform absorption tests of stones and mortar using RILEM tubes in conformance with RILEM Test Method II.4. Prepare written reports of both sets of tests and submit to Architect and Owner.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Replacement stone units and their jointing, showing relation of existing to new units.
2. Provisions for expansion joints or other sealant joints.

C. Samples: For each exposed product and for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.

1.7 QUALITY ASSURANCE

A. Restoration Specialist Qualifications: Engage an experienced stone restoration and cleaning firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry or new stone masonry is not sufficient experience for stone restoration work.

1. At Contractor's option, work may be divided between two specialist firms: one for cleaning work and one for repair work.
2. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that stone restoration and cleaning work is in progress.
3. Restoration Worker Qualifications: Persons who are experienced in restoration work of types they will be performing. **When stone units are being patched, assign at least one worker among those performing patching work who is trained and certified by manufacturer of patching compound to apply its products.**

B. Mockups: Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.

1. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than 2 adjacent whole units.. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:
   a. Patching: Three small holes at least 1 inch (25 mm) in diameter.

2. Repointing: Rake out joints in 2 separate areas **, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide** for each type of repointing required and repoint one of the areas.
3. Cleaning: Clean an area **approximately 25 sq. ft. (2.3 sq. m)** for each type of stone and surface condition.

C. Preinstallation Conference: Conduct conference at **Project site**.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

A. Stone: Provide natural building stone of variety, physical properties, color, texture, grain, veining, finish, size, and shape to match existing stone.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, white **or gray or both** where required for color matching of exposed mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Sand: ASTM C 144 unless otherwise indicated.

1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
2. For pointing mortar, provide sand with rounded edges.
3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

E. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Stone Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.

1. Products: Subject to compliance with requirements, **provide one of the following**:

a. Cathedral Stone Products, Inc.; Jahn Restoration Mortars.
b. Edison Coatings, Inc.; Custom System 45.

2. Use formulation that is vapor- and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all types of stone.
3. Formulate patching compound in colors, textures, and grain to match stone being patched.

B. Stone-to-Stone Adhesive: **2-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F (21 deg C) or 1-part cementitious stone adhesive**, recommended by adhesive manufacturer for type of stone repair indicated, and matching stone color.

1. Products: Subject to compliance with requirements, **provide one of the following**:

a. Two-Part Polyester or Epoxy-Resin Stone Adhesive:

1) Akemi North America; **MS76 Stone and Marble Adhesive**.
2) Bonstone Materials Corporation; Fast Set 41.
3) Edison Coatings, Inc.; Flexi-Weld 520T.

b. One-Part Cementitious Stone Adhesive:

1) Cathedral Stone Products, Inc.; Jahn Restoration Adhesive.

2.4 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

1. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Price Research, Ltd.; Price Marble Cleaner-Gel.
b. PROSOCO; Sure Klean 942 Limestone and Marble Cleaner.
c. <**Insert manufacturer's name; product name or designation**>.

2.5 ACCESSORY MATERIALS

A. Stone Anchors **and Pins**: Type and size indicated or, if not indicated, to match existing anchors in size and type. Fabricate anchors **and pins** from **Type 304** stainless steel.

B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

2.6 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until

mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Stone: **1 part white portland cement, 2 parts lime, and 6 parts sand**.

a. Add mortar pigments to produce mortar colors required.

2. Rebuilding (Setting) Mortar: Same as pointing mortar **except mortar pigments are not required**.

2.7 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Unpolished Stone: Dilute with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical-cleaner manufacturer.

C. Acidic Cleaner for Polished Stone: Dilute with water to concentration demonstrated by testing that does not etch or otherwise damage polished surface, but not greater than that recommended by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from stone restoration work.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply

with manufacturer's written instructions. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Keep wall wet below area being cleaned to prevent streaking from runoff.

3.2 STONE REMOVAL AND REPLACEMENT

A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair. Carefully demolish or remove entire units from joint to joint, without damaging surrounding stone, in a manner that permits replacement with full-size units.

B. Support and protect remaining stonework that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

D. Remove in an undamaged condition as many whole stone units as possible.

1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to stone with utility knife and cleaning with solvents.

E. Clean stone surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Replace removed damaged stone with other removed stone in good quality, where possible, or with new stone matching existing stone, including size. Do not use broken units unless they can be cut to usable size.

G. Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, natural bedding planes are essentially horizontal. Reject and replace stones with vertical bedding planes except as required for arches, lintels, and copings.

H. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

1. Maintain joint width for replacement stone to match existing joints.
2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

I. Set replacement stone with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors of size and type indicated.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.

2. Rake out mortar used for laying stone before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing stone, and at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.3 STONE-FRAGMENT REPAIR

A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material, from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, **plain** stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into parent stone and into, but not through, the fragment. Center and space pins between 3 and 5 inches (75 and 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) into parent stone and 2 inches (50 mm) into fragment, but no closer than 3/4 inch (19 mm) from exposed face of fragment.

D. Apply stone-to-stone adhesive to comply with adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.

E. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

F. Clean adhesive residue from exposed surfaces and patch chipped areas **and exposed drill holes** as specified in "Stone Patching" Article.

3.4 STONE PATCHING

A. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1/4 inch (6 mm) thick, but not less than recommended by patching compound manufacturer.

B. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of stone unit.

C. For patches more than 3” thick, apply stainless steel furring at back of area to be patched.

D. Mix patching compound in individual batches to match each stone unit being patched.

E. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.

F. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.

1. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.

G. Keep each layer damp for 72 hours or until patching compound has set.

H. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.5 CLEANING STONE, GENERAL

A. Proceed with cleaning in an orderly manner; work from **bottom to top**] [**t**of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.

B. Use only those cleaning methods indicated for each stone material and location.

1. Do not use wire brushes or brushes that are not resistant to chemical cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage stone.

a. Equip units with pressure gages.

3. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip.
4. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
5. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging stone surfaces.

D. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface of stone and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

E. Chemical-Cleaner Application Methods: Apply chemical cleaners to stone surfaces to comply with chemical-cleaner manufacturer's written instructions; use brush **or spray** application. **Do not spray apply at pressures exceeding 50 psi (345 kPa).** Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.

F. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.6 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from stone surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil or debris from open joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to cleaning methods being used. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of material from surface of stone with sharp chisel. Do not scratch or chip stone surface.
2. Remove paint and calking with alkaline paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without prewetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.7 CLEANING STONEWORK

A. Detergent Cleaning:

1. Wet stone with **cold** water applied by low-pressure spray.
2. Scrub stone with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that stone surface remains wet.
3. Rinse with **cold** water applied by **low**-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet stone with **cold** water applied by low-pressure spray.

2. Apply mold, mildew, and algae remover by brush **or low-pressure spray**.
3. Scrub stone with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that stone surface remains wet.
4. Rinse with **cold** water applied by **low**-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

C. Nonacidic Liquid Chemical Cleaning:

1. Wet stone with **cold** water applied by low-pressure spray.
2. Apply cleaner to stone by brush. Let cleaner remain on surface for period indicated below:

    a. As recommended by chemical-cleaner manufacturer.

3. Rinse with **cold** water applied by **low**-pressure spray to remove chemicals and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.8 REPOINTING STONEWORK

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints where mortar is missing or where they contain holes.
3. Cracked joints where cracks can be penetrated at least 1/4 inch (6 mm) by a knife blade 0.027 inch (0.7 mm) thick.
4. Cracked joints where cracks are [**1/16 inch (1.6 mm)**] [**1/8 inch (3 mm)**] <**Insert dimension**> or more in width and of any depth.
5. Joints where they sound hollow when tapped by metal object.
6. Joints where they are worn back 1/4 inch (6 mm) or more from surface.
7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
8. Joints, other than those indicated as sealant-filled joints, where they have been filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of **2-1/2 times joint width**, but not less than 1/2 inch (13 mm) or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.

a. Cut out mortar using the same methods as approved with the mockup. Do not alter method without written approval from the Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.9 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040140

SECTION 040140.61 - STONE REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repairing stone masonry.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of replacement stone units on the structure and their jointing.
2. Show partial replacement stone units (dutchmen).
3. Show provisions for expansion joints or other sealant joints.
4. Show replacement and repair anchors, including drilled-in pins.

C. Samples: For each exposed product and for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.7 QUALITY ASSURANCE

A. Stone Repair Specialist Qualifications: Engage an experienced stone repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to

that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repair work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of stone repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

A. Stone Matching Existing: Natural building stone of variety, color, texture, grain, veining, finish, size, shape, and physical properties that match existing stone.

1. For existing stone that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

B. Cutting New Stone: Cut each new stone so that, when it is set in final position, the rift or natural bedding planes will match the rift orientation of existing stones. If stone will not be visible at completion of the project, orient the bedding planes to be in compression.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Cement: ASTM C1329/C1329M.

D. Mortar Sand: ASTM C144.

1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

E. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in stone mortars.

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. Davis Colors.
b. LANXESS Corporation.
c. Solomon Colors, Inc.

2. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than stone units being repaired, and develops high bond strength to all types of stone.
3. Formulate patching compound in colors, textures, and grain to match stone being patched.

F. Cementitious Crack Filler: Ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of stone.

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. Cathedral Stone Products, Inc.
b. Edison Coatings, Inc.

G. Stone-to-Stone Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F (21 deg C), recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.

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. Akemi North America.
b. Cathedral Stone Products, Inc.
c. Edison Coatings, Inc.

2.3 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.4 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
1. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime or mortar cement.
2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove downspouts and associated hardware adjacent to stone and store during stone repair. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 STONE REMOVAL AND REPLACEMENT

A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair. Carefully remove entire units from joint to joint, without damaging surrounding stone, in a manner that permits replacement with full-size units.

B. Support and protect remaining stonework that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole stone units as possible.

1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to stone with utility knife and cleaning with solvents.

F. Clean stone surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.

G. Replace removed damaged stone with other removed stone in good condition, where possible, matching existing stone, including direction of rift or natural bedding planes. Do not use broken units unless they can be cut to usable size.

H. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

1. Maintain joint width for replacement stone to match existing joints.
2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

I. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting, and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors matching existing configuration.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.
2. Rake out mortar used for laying stone before mortar sets according to Section 040140.62 "Stone Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.3 PARTIAL STONE REPLACEMENT

A. Remove defective portion of existing stone unit (backing stone). Carefully remove defective portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman).

1. Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face.
2. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.
3. If backing stone becomes damaged further, remove damaged area and enlarge partial replacement as required.

B. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.

C. Cut and trim partial replacement to accurately fit area where material was removed from backing stone. Fabricate to size required to produce joints between partial replacement and backing stone of no more than 1/16 inch (1.6 mm) in width, and joints between partial replacement and other stones that match existing joints between stones.

D. Exposed Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of partial replacement and into backing stone.

E. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into backing stone and into, but not through, the partial replacement.

F. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of backing stone and partial replacement, completely filling all crevices and voids.

G. Apply partial replacement while adhesive is still tacky and hold securely in place until adhesive has cured. Use temporary shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of backing stone.

H. Clean adhesive residue from exposed surfaces and patch chipped areas as specified in "Stone Patching" Article.

3.4 STONE PLUG REPAIR

A. Remove cylindrical piece of damaged stone by core-drilling perpendicular to stone surface.

B. Prepare a replacement plug by core-drilling replacement stone. Use a drill sized to produce a core that will fit into hole drilled in damaged stone with only minimum gap necessary for adhesive.

C. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of existing stone and plug, completely filling all crevices and voids.

D. Apply plug while adhesive is still tacky and hold securely in place until adhesive has cured.

E. Clean adhesive residue from exposed surfaces.

3.5 STONE-FRAGMENT REPAIR

A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into parent stone and into, but not through, the fragment.

E. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.

F. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.6 CRACK INJECTION

A. General: Comply with cementitious crack-filler manufacturer's written instructions.

B. Drill 1/4-inch- (6-mm-) diameter injection holes as follows:

1. Transverse Cracks Less Than 3/8 inch (9 mm) Wide: Drill holes through center of crack at 12 to 18 inches (300 to 500 mm) o.c.
2. Drill holes 2 inches (50 mm) deep.

C. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.

D. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.

E. Inject cementitious crack filler through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward. Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material and begin injecting filler at adjacent port, repeating process until all ports have been injected.

F. Clean cementitious crack filler from face of stone before it sets by scrubbing with water.

G. After cementitious crack filler has set, remove injection ports, plugging material, and excess filler. Patch injection holes and surface of cracks as specified in "Stone Patching" Article.

3.7 STONE PATCHING

A. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.

B. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of stone unit.

C. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.

D. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.

E. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.

1. Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.
2. Carved Details: Build patch up 1/4 inch (6 mm) above surrounding stone, and carve surface to match adjoining stone after patching compound has hardened.

F. Keep each layer damp for 72 hours or until patching compound has set.

G. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040140.61

SECTION 040140.62 - STONE REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repointing joints with mortar.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.6 QUALITY ASSURANCE

A. Stone Repointing Specialist Qualifications: Engage an experienced stone repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of stone repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide unless otherwise indicated for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

E. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in stone mortars.

F. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
   1. Pointing Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime or mortar cement.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to stone and store during stone repointing. Reinstall when repointing is complete.

   1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING

A. Rake out and repoint joints to the following extent:

   1. All joints in areas indicated.
   2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
   3. Joints at locations of the following defects:

      a. Holes and missing mortar.
      b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
      c. Cracks 1/8 inch (3 mm) or more in width and of any depth.
      d. Hollow-sounding joints when tapped by metal object.
      e. Eroded surfaces 1/4 inch (6 mm) or more deep.
      f. Deterioration to point that mortar can be easily removed by hand, without tools.
      g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

   1. Remove mortar from joints to depth of 2-1/2 times joint width and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.
   2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
   3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040140.62

SECTION 040310 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of cleaning historic clay brick, terra cotta, and stone masonry surfaces.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 (2750 to 5510) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and cleaning.
2. Review methods and procedures related to cleaning historic masonry.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of masonry and surface condition.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry; containing no methanol or methylene chloride.

2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.3 CHEMICAL-CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

A. Have cleaning work performed only by qualified historic treatment specialist.

B. Proceed with cleaning in an orderly manner; work from bottom to top of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

a. Equip units with pressure gauges.
b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.

D. Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

1. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface, and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

F. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

G. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, caulking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.

3.4 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using medium-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer.
5. Scrape off paint and remover.
6. Rinse with cold water applied by medium-pressure spray to remove chemicals and paint residue.

3.5 CLEANING MASONRY MATERIALS

A. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar

joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.

3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

C. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with [cold] [hot] water applied by low-pressure spray.
2. Apply cleaner to surface[in two applications] by brush[or low-pressure spray].
3. Let cleaner remain on surface for period [recommended in writing by chemical-cleaner manufacturer] [established by mockup] [of two to three minutes] <Insert requirement>.
4. Rinse with [cold] [hot] water applied by [low] [medium]-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection and provide on-site assistance when requested by Architect. Have chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once to observe progress and quality of the Work.

END OF SECTION 040310

SECTION 040322 - HISTORIC BRICK UNIT MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repairing historic clay brick masonry.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: **100 to 400 (690 to 2750)** psi (kPa).
2. Flow Rate: **4 to 6 (0.25 to 0.4)** gpm (L/s).

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **Project site**.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repair.
2. Review methods and procedures related to repairing historic brick masonry.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of masonry repair work on the structure.
2. Show provisions for expansion joints or other sealant joints.
3. Show replacement and repair anchors. Include details of anchors

C. Samples: For each exposed product and for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic brick masonry repair specialist. Experience installing standard unit masonry is insufficient experience for masonry historic treatment work.

1. Historic Treatment Worker Qualifications: **When bricks are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products**.

B. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: **Four** brick units replaced.
b. Patching: Three small holes **at least 1 inch (25 mm) in diameter** for each type of brick indicated to be patched, so as to leave no evidence of repair.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick: Units, including molded, ground, cut, or sawed shapes as required to complete masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork.

2. Special Shapes:

a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position, and where shapes produced by sawing would result in sawed surfaces being exposed to view.
b. Provide specially ground units, shaped to match patterns and where indicated.
c. Mechanically chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

B. Building Brick: ASTM C62, Grade SW where in contact with earth, Grade SW, MW, or NW for concealed backup; of same vertical dimension as face brick, for masonry work concealed from view.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white **or gray or both** where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. For exposed mortar, provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than the bricks being repaired, and develops high bond strength to all types of masonry.
3. Formulate patching compound used for patching brick in colors and textures to match each unit being patched. Provide [**sufficient number of**] [**not less than three**] <**Insert number**> colors to enable matching the color, texture, and variation of each unit.

2.4 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.

2.5 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, [**1 part portland cement, 2 parts lime, and 7 parts sand**] [**1 part portland cement, 4 parts lime, and 12 parts sand**] <**Insert proportions**>.
2. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, [**Type N**] [**Type O**] <**Insert type**> unless otherwise indicated; with cementitious material limited to portland cement and lime.
3. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, [**Type N**] [**Type O**] <**Insert type**> unless otherwise indicated; with cementitious material limited to portland cement and lime.
4. Rebuilding (Setting) Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to [**portland cement and lime**] <**Insert binder(s)**>, and with a volume ratio of [**1 part portland cement, 1 part lime, and 6 parts sand**] <**Insert proportions**>.
5. Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove[**gutters and**] downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

3.3 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated[**or are to be reused**]. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible. Remove mortar and sealant from surfaces of removed units.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets according to Section 040323 "Historic Brick Unit Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.4 BACKUP MASONRY REMOVAL AND REPLACEMENT

A. Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated and rebuild with whole, new brick or whole salvaged backup masonry units. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Perform backup masonry removal and replacement according to requirements in "Brick Removal and Replacement" Article.

3.5 BRICK MASONRY PATCHING

A. Patch the following bricks unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners.[**Patch chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.**]
4. Units with small areas of deep deterioration.[**Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and more than 1/4 inch (6 mm) deep.**]

B. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least [**1/4 (6)**] <**Insert dimension**> inch(es) (mm) thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.6 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.

2. Do not use acidic or alkaline cleaners.

END OF SECTION 040322

SECTION 040323 - HISTORIC BRICK UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repointing brick masonry joints.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: [4 to 6 (0.25 to 0.4)] gpm (L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repointing.
2. Review methods and procedures related to repointing historic brick masonry.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. Provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
1. Pointing Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove downspouts and associated hardware adjacent to immediate work area and store during masonry repointing work. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

3.3 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 (1.6) inch(es) (mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times joint width. Do not remove unsound mortar more than 2 (50) inches (mm) deep; consult Architect for direction.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of bricks or widen joints. Replace or patch damaged bricks as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 (9) inch(es) (mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 (9) inch(es) (mm). Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing brick have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040323

SECTION 050371 - HISTORIC DECORATIVE METAL CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative metal in the form of cleaning as follows:

1. Cleaning metal.
2. Removing paint.
3. Removing corrosion.
4. Priming for repainting.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 (2750 to 5510) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal cleaning specialist. Cleaning specialist shall be experienced in using mechanical and chemical methods on the types of metal surfaces indicated.

B. Mockups: Prepare mockups of historic treatment cleaning processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous.

1. Cleaning: Prepare an area approximately 2 sq. ft. (0.2 sq. m) for each process on each type of metal indicated for treatment.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

C. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Building Restoration Products, Inc.
b. Cathedral Stone Products, Inc.
c. PROSOCO, Inc.

D. Abrasive Materials:
1. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from metals; and containing no methanol or methylene chloride.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Building Restoration Products, Inc.
b. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
c. EaCo Chem, Inc.
d. PROSOCO, Inc.

2.3 FERROUS METAL PRIMERS

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free, universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry-film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed historic metal.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE METAL CLEANING, GENERAL

A. Execution of the Work: In cleaning historic items, disturb them as minimally as possible and as follows:

1. Remove deteriorated coatings and corrosion.
2. Sequence work to minimize time before protective coatings are reapplied.
3. Clean items in place unless otherwise indicated.

B. Mechanical Coating Removal: Use most gentle mechanical methods, such as scraping and wire brushing, that will not abrade metal substrate. Do not use abrasive methods such as sanding or power tools except as indicated as part of the historic treatment program and approved by Architect.

C. Repaint: Where indicated, prepare painted decorative metal by cleaning surface, removing less than firmly adhered existing paint, sanding edges smooth, and priming for painting as specified.

3.2 CLEANING

A. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

a. Equip units with pressure gages.
b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.

c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: Clean with cold water applied by low-pressure spray. Supplement with natural-fiber or plastic bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure where needed if required to produce cleaning effect established by mockup.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface by brush[or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or as established by mockup
4. Non-Ferrous Metals: Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.
6. Repeat cleaning procedure where needed if required to produce cleaning effect established by mockup. Do not repeat more than once.

E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt by rubbing with abrasive pads and water. Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

F. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 PAINT REMOVAL

A. Use only those paint-removal methods indicated for each type of decorative metal.

1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
2. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. Unless otherwise indicated, hold spray nozzle at least 6 inches (152 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
    c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with cone-shaped spray.
    d. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.

B. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by testing.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

3.4 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

END OF SECTION 050371

SECTION 050372 - HISTORIC DECORATIVE METAL REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Historic treatment of decorative metal in the form of repair as follows:

a. Repairing metals other than cast iron and replacing damaged and missing components in place.
b. Removing and dismantling metal for shop repair and replacement of components; reinstalling repaired metal.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to historic decorative metal repair.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, methods of attachment, accessory items, and finishes.

C. Samples: For each exposed product and for each color and texture specified.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal repair specialist. Experience installing and finishing new decorative metal work is insufficient experience for decorative metal historic treatment work.

B. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Provide metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated.

2.2 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

C. Abrasive Materials:

1. Abrasive Pads: Non-scratch, of the following types:

    a. Abrasive Pad with Sponge: Combination plastic abrasive pad, consisting of a sponge enclosed with a woven urethane, polypropylene, or other plastic mesh or fabric, without other abrasive components that can scratch metal.
    b. Abrasive Pad of Plant Fibers: Agave, loofa, or another tough plant fiber, without other abrasive components that can scratch metal.

2. Medium Abrasives for Ferrous Metals: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
3. Medium Abrasives for Copper Alloys: Extra fine bronze wool or plastic abrasive pads.

D. Wash Cloths: Lint-free, absorbent, durable cloth without abrasives that can scratch metal.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.3 FASTENERS

A. Fasteners: Fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting decorative metal components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated or another head is required to match the existing fastening method as determined by Architect.
4. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.

2.4 ACCESSORIES

A. Metal-Patching Compound: Two-part, epoxy- or polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion or deformation. Filler shall be capable of filling deep holes and spreading to feather edge.

B. Brazing Rods for Copper Alloys: Type and alloy as recommended in writing by brazing-rod manufacturer and as required for color match, strength, and compatibility in fabricated items.

C. Welding Electrodes and Filler Metal: Select according to AWS specifications for metal alloy welded; use metal type and alloy as required for color match, strength, and compatibility in fabricated items.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 METAL FABRICATION

A. Custom fabricate repairs of decorative metal items and components in sizes and profiles to match existing decorative metal unless otherwise indicated, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

C. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

D. Castings: Fabricate castings free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

1. Finish castings to match existing decorative metal work.

2.6 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed metal.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE METAL REPAIR, GENERAL

A. Execution of the Work: In repairing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize decorative metal to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove deteriorated coatings and corrosion.
3. Sequence work to minimize time before protective coatings are reapplied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair items in place unless otherwise indicated and retain as much original material as possible.
6. Replace or reproduce historic items where indicated or scheduled.
7. Make historic treatment of materials reversible whenever possible.
8. Install temporary protective measures to stabilize decorative metal that is indicated to be repaired later.

B. Mechanical Coating Removal: Use gentlest mechanical methods, such as scraping and wire brushing, that do not abrade metal substrate. Do not use abrasive methods, such as sanding, or power tools except as approved by Architect.

C. Repairing Decorative Metal Items: Match existing materials and features, retaining as much original material as possible to complete the repair.

D. Replacing Decorative Metal Components: Where indicated, duplicate and replace items with new metal matching existing metal.

1. Replace heavily deteriorated or missing parts or features of decorative metal with compatible materials, using surviving prototypes to create patterns or molds for duplicate replacements.

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing repair work. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: Clean with cold water applied with low-pressure spray. Supplement with natural-fiber or plastic bristle brush and abrasive pads. Use small brushes to remove soil and loose paint from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with cold water applied with low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush and abrasive pads until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied with low-pressure spray to remove detergent solution and soil.

D. Mechanical Rust Removal:

1. Remove rust with approved, medium abrasives for ferrous metals.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 DISMANTLING, REPAIR, AND INSTALLATION

A. Repair decorative metal in place insofar as practicable, unless otherwise indicated. Where necessary, dismantle components from their substrate and repair and reinstall them.

B. Installation:

1. Locate and place decorative metal iron items level and plumb and in alignment with adjacent construction.

a. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

2. Use concealed anchorages where possible, unless otherwise indicated.
3. Form tight joints with exposed connections accurately fitted together.
4. Install concealed joint fillers, sealants, and flashings, as the Work progresses, to make exterior items weatherproof.
5. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
6. Touch Up: At completion of installation, touch up and restore damaged or defaced finish surfaces and fastener heads.

C. Reinstalling Railing Posts: After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup sloped away from post.

D. Sealant: See Section 079200 "Joint Sealants."

3.4 FILLING DEFECTS IN PAINTED SURFACES

A. Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/8 inch (3 mm) deep or 1 inch (25 mm) across and all holes and tears by filling with metal-patching compound. Remove burrs. Prime iron and steel surfaces immediately after repair to prevent flash rusting.

3.5 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.6 HISTORIC DECORATIVE METAL REPAIR SCHEDULE

This schedule demonstrates a method to indicate extensive historic treatment requirements for decorative metal. This schedule is an example only; revise to suit Project and coordinate with historic decorative metal schedules in Section 050371 "Historic Decorative Metal Cleaning" and Section 050373 "Historic Decorative Metal Refinishing," if retained.

Insert drawing designation for each item to be treated, and indicate the methods of treatment that apply to the item. Use these designations on Drawings to identify locations.

A. Treatment of Decorative Railing [**DMR-1**] <**Insert drawing designation**>: Wrought-iron railing and gate.

1. Perform work [**in the shop**] [**or**] [**in the field**].

2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Repairs: Repair railing and replace missing components with hand-worked [**steel bars**] [**wrought iron**].
4. Painted Finish: As specified in [**Section 090391 "Historic Treatment of Plain Painting."**] <**Insert Section number and title.**>
5. Baked-Enamel or Powder-Coat Finish: [**Color as indicated by manufacturer's designations**] [**Color matching design reference sample**] [**Color matching Architect's sample**] [**Color as selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.
6. Gilding: As specified in [**Section 090398 "Historic Treatment of Gilding."**] <**Insert Section number and title.**>

B. Treatment of Decorative Railing [**DMR-2**] <**Insert drawing designation**>: Bronze railing with bronze handrail.

1. Perform work [**in the shop**] [**or**] [**in the field**].
2. Cleaning: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Repair: [**Splice new material into deteriorated section**] <**Insert description**>.
4. Bronze Finish: [**Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail**] <**Insert requirement**>.

C. Treatment of Decorative Railing and Handrail [**DMRH-1**] <**Insert drawing designation**>: Deteriorated [**bronze**] [**wood**] handrail on wrought-iron railing.

1. Repair: Replace broken wrought-iron railing components and repaint railing. Replace entire, deteriorated [**bronze**] [**wood**] handrail with shop-fabricated [**aluminum**] [**steel**] [**wood**] <**Insert material**> handrail. Replicate wrought-iron as specified in Section 050374 "Historic Decorative Metal Replication."
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Railing Finish: Paint as specified in [**Section 090391 "Historic Treatment of Plain Painting."**] <**Insert Section number and title.**>

    a. Color: [**As indicated by manufacturer's designations**] [**Matching design reference sample**] [**Matching Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

4. Gilding: As specified in [**Section 090398 "Historic Treatment of Gilding."**] <**Insert Section number and title.**>
5. Handrail Finish:

Retain "Aluminum Finish" or "Baked-Enamel or Powder-Coat Finish" Subparagraph below. Aluminum finishes are shop applied on new assemblies or components to suit Project. Refinishing is specified in Section 050373 "Historic Decorative Metal Refinishing." Insert other finishes to suit Project.

    a. Aluminum Finish: [**Light bronze anodized**] [**Medium bronze anodized**] [**Dark bronze anodized**] [**Anodized color matching design reference sample**] [**Anodized color matching Architect's sample**] [**Anodized color as selected by Architect from full range of industry colors and color densities**] <**Insert color**>.
    b. Baked-Enamel or Powder-Coat Finish: [**Color as indicated by manufacturer's designations**] [**Color matching design reference sample**] [**Color matching**

Architect's sample] [**Color as selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

END OF SECTION 050372

SECTION 050373 - HISTORIC DECORATIVE METAL REFINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative metal in the form of refinishing bare metal surfaces as follows:

1. Refinishing metal in place.
2. Removing and dismantling metal for shop refinishing; reinstalling refinished metal.
3. Integral metal finishes.
4. Metallic-plated finishes.
5. Clear protective coatings.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 050371 "Historic Decorative Metal Cleaning" for cleaning and removing paint from historic metalwork.
3. Section 090391 "Historic Treatment of Plain Painting" for plain painting of historic metalwork.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: **100 to 400 (690 to 2750)** psi (kPa).
2. Flow Rate: **4 to 6 (0.25 to 0.4)** gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: **400 to 800 (2750 to 5510)** psi (kPa).
2. Flow Rate: **4 to 6 (0.25 to 0.4)** gpm (L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **Project site**.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal refinishing specialist.

B. Mockups: Prepare mockups of historic treatment refinishing processes to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous or reversible.

1. Refinishing Decorative Metal: Refinish **one** decorative for each type of metal indicated to be refinished.
2. Repairing Decorative Metal Finish: Repair finish of **one** decorative for each type of metal finish indicated to be repaired.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

C. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

Abrasives can be used for paint removal as well as for cleaning surfaces, depending on the abrasive type and how it is used.

D. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra-fine bronze wool or plastic abrasive pads.

Revise "Abrasives for Ferrous Metal Cleaning" Subparagraph below if mechanically cleaning stainless-steel surfaces; allow only stainless-steel tools. Carbon-steel residues can rust and stain stainless-steel surfaces.

2. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

2.2 PROTECTIVE COATING MATERIALS

Retain "Wax Coating" or "Organic Coating" Paragraph below, or both, to suit Project; if retaining more than one coating, indicate location of each on Drawings or by inserts. First paragraph specifies a wax coating commonly used for application to exterior bronze statuary after cleaning and patinizing; it generally requires reapplying annually or biennially. Waxes can also be applied to other metals but are generally not applied over painted coatings.

BWC Company products are carnauba-based waxes with solvents. Its "Boston Polish Wax" is amber, its "Bowling Alley Wax" is clear, and its "New England Brown Wax" is dark brown.

Fisher Scientific products are yellow carnauba wax flakes or powder without solvent.

Real Milk Paint Co. products are carnauba wax with or without solvents. Its "Carnauba Wax Flakes" vary from yellow to light brown and are without solvent, and its "Carnauba Wax Paste" is with solvent.

Talas products are waxes without solvents. Its "Be Sq #175 Microcrystalline Wax" is amber microcrystalline wax, its "Carnauba Wax" is pure carnauba wax flakes (No. 1, yellow), and its "Cosmolloid 80 H" and "Victory White Microcrystalline Wax" are clear microcrystalline waxes.

A. Wax Coating: Inert, high-melting-point wax or wax blend, consisting primarily of [**carnauba**] [**or**] [**microcrystalline petroleum**] wax[**and no solvents**].

   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

"Organic Coating" Paragraph below specifies a resin coating commonly used for application to exterior bronze statuary after cleaning and patinizing; it generally requires removing and reapplying every five years or less. It can be applied to other metals but is generally not applied over painted coatings.

B. Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole UV inhibitor.

   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.3 ALUMINUM FINISHES

Retain finishes in this article for bare aluminum assemblies or components to suit Project. If retaining more than one, indicate location of each on Drawings or by inserts. Primers and paint finishes for aluminum are specified in other Sections.

A. Unfinished: No applied finish; only preparatory cleaning.

Retain one of first two options in "Clear Anodic Finish" Paragraph below. This finish is shop applied. Class II finish is standard with many manufacturers; Class I finish is heavy anodized. Verify availability with manufacturer. Revise last three options if custom mechanical finish is required and availability is verified.

B. Clear Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker over a [**satin (directionally textured)**] [**polished (buffed)**] [**nonspecular as fabricated**] <**Insert requirement**> mechanical finish.

Retain one of first two options in "Color Anodic Finish" Paragraph below. This finish is shop applied. Class II finish is standard with many manufacturers; Class I finish is heavy anodized. Verify availability with manufacturer. Revise last three options if custom mechanical finish is required and availability is verified. Indicate color on Drawings or in the Historic Decorative Metal Refinishing Schedule.

C. Color Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker over a [**satin (directionally textured)**] [**polished (buffed)**] [**nonspecular as fabricated**] <**Insert requirement**> mechanical finish.

2.4 COPPER-ALLOY FINISHES

Retain finishes in this article for bare copper-alloy assemblies or components to suit Project. If retaining more than one, indicate location of each on Drawings or by inserts.

A. Finish designations for copper alloys comply with the system defined in NAAMM/NOMMA 500, "Metal Finishes Manual for Architectural and Metal Products."

"Buffed Finish," "Buffed Finish, Lacquered," "Satin Hand-Rubbed Finish," and "Satin Hand-Rubbed Finish, Lacquered" paragraphs below specify natural-color finishes. Retain first paragraph for finish that weathers and changes color naturally over time unless clear coated with wax, oil, or organic coating. Insert wax or oil coating if required.

B. Buffed Finish: [**M21 (buffed, smooth specular mechanical finish)**] [**M22 (buffed, specular mechanical finish)**] <**Insert description**>.

C. Buffed Finish, Lacquered: [**M22 (buffed, specular mechanical finish; specified clear organic coating)**] <**Insert description**>.

Retain "Satin Hand-Rubbed Finish" Paragraph below for finish that weathers and changes color naturally over time unless clear coated with wax, oil, or organic coating. Insert wax or oil coating if required.

D. Satin Hand-Rubbed Finish: [**M32-M34 (directionally textured, medium satin and hand-rubbed mechanical finishes)**] <**Insert description**>.

E. Satin Hand-Rubbed Finish, Lacquered: [**M32-M34-06x (directionally textured, medium satin and hand-rubbed mechanical finishes; specified clear organic coating)**] <**Insert description**>.

Remaining three paragraphs below specify patinated finishes. Patinated finishes are generally used in nontraffic locations where there is little or no maintenance; clear organic coating, hot wax, or oil can be applied to improve wear resistance. Verify, with manufacturers, the suitability of patinas for exterior exposure, if required, and requirements for clear protective coatings.

F. Satin Finish with Statuary Conversion Coating: [**M32-C55 (directionally textured, medium satin; sulfide conversion coating)**] <**Insert description**>.

1. Color: [**Match design reference sample**] [**Match existing**] [**Match Architect's sample**] <**Insert color**>.

Coarseness of finish in "Brushed Finish with Patina Conversion Coating" Paragraph below is controlled by diameter and speed of wheel and pressure exerted.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: [**Match design reference sample**] [**Match existing**] [**Match Architect's sample**] <**Insert description**>.

Retain paragraph below for proprietary patina finish not listed above. Patina finishes are available from manufacturers listed in "Manufacturers" Article in the Evaluations.

H. <**Insert name**> Patina Finish: <**Insert description**>.

2.5 FERROUS METAL FINISHES

Retain "Patina Finish" Paragraph below for patina finish on bare iron or steel. Insert other finishes to suit Project.

A. Patina Finish: <**Insert description**>.

2.6 STAINLESS-STEEL FINISHES

Retain finishes in this article for bare stainless-steel assemblies or components to suit Project. These finishes can be shop or field applied. If retaining more than one, indicate location of each on Drawings or by inserts.

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

Retain "Restored Finish" Paragraph below for finish applied to match existing stainless steel or Architect's sample.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match [**existing finish**] [**Architect's sample**], free of cross scratches.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

Generally, retain "Polished Finishes" Paragraph below for stainless steel not required to match existing stainless steel; revise to suit Project.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches, according to [**ASTM A480/A480M**] <**Insert requirement**>.

Retain first subparagraph below for directional finishes.

1. Run grain of directional finishes with long dimension of each piece.

2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.
4. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE METAL REFINISHING, GENERAL

Revise this article to suit Project. See Section 013591 "Historic Treatment Procedures" for general historic treatment procedures.

A. Have decorative metal refinishing performed by a qualified decorative metal refinishing specialist.

Retain "Refinishing Appearance Standard" Paragraph below to control overall appearance from a distance.

B. Refinishing Appearance Standard: Refinished surfaces are to have a uniform appearance as viewed from [**20 (6)**] [**50 (15)**] <**Insert distance**> feet (m) away by Architect.

C. Execution of the Work: In refinishing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Remove dirt and corrosion.
2. Sequence work to minimize time before protective coatings are reapplied.
3. Refinish items in place unless otherwise indicated and retain as much original finish as possible and according to required appearance.
4. Make historic treatment of materials reversible whenever possible.

D. Refinishing Decorative Metal Item: Remove existing metal finishes on item unless otherwise indicated[**, including integral polished and patinated finishes and plated finishes,**] and [**reapply them**] [**apply new, specified finishes**].

E. Repairing Finish of Decorative Metal Item: Restore areas of deteriorated or missing finish on item and blend restored finish with existing, adjacent finish[**, including integral polished and patinated finishes and plated finishes**].

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing refinishing work. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

a. Equip units with pressure gauges.

Retain first subparagraph below unless spray application of chemical cleaners is unacceptable. Wind drift of chemical cleaners is often a problem with spray application.

b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.

Fan-spray angle in first subparagraph below is considered efficient for low and medium pressure and less harmful than sprays with narrower angles. Never use a fan spray with an angle of less than 15 degrees.

c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.

Retain first subparagraph below if heated water is required. Revise temperature range to suit Project.

d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: Clean with [**cold**] [**hot**] water applied by low-pressure spray. Supplement with [**natural-fiber**] [**or**] [**plastic**] bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with [**cold**] [**hot**] water applied by low-pressure spray.
2. Scrub surface with detergent solution and [**natural-fiber**] [**or**] [**plastic**] bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.[**Leave uniform patina intact.**]
3. Rinse with [**cold**] [**hot**] water applied with [**sponges or wash cloths**] [**low-pressure spray**] [**medium-pressure spray**] to remove detergent solution and soil.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. Wet surface with [**cold**] [**hot**] water applied by low-pressure spray.
2. Apply cleaner to surface[**in two applications**] by brush[**or low-pressure spray**].

Retain one option in first subparagraph below; revise to suit Project. Third option is an example only.

3. Let cleaner remain on surface for period [**recommended in writing by chemical-cleaner manufacturer**] [**established by mockup**] [**of two to three minutes**] <**Insert requirement**>.
4. Non-Ferrous Metals: Rinse with [**cold**] [**hot**] water applied by [**low**] [**medium**]-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.

Generally, retain first option in "Cleaning with Abrasive Pads" Paragraph below for decorative metals with desirable patina. This method can remove patina if used aggressively.

E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt[**, leaving uniform patina intact,**] by light rubbing with abrasive pads and water. [**Rinse with cold water to remove residue. Apply rinse by low-pressure spray**] [**Do not rinse ferrous metals with water; wipe with damp cloths to remove residue**] <**Insert requirement**>.

3.3 PROTECTIVE COATING

Retain "Protective Hot-Wax Coating" or "Protective Organic Coating" Paragraph below, or both, to suit Project; if retaining both, indicate location of each on Drawings or by inserts.

A. Protective Hot-Wax Coating: Apply wax coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being waxed.
2. Preheat surface to about 212 deg F (100 deg C); hot enough to melt the wax and remove water vapor and other gases within metal surface, but not hot enough to boil the wax or ignite solvents, if any.
3. Apply uniform wax coating to surface, ensuring that wax coverage is complete, including recesses.[**Apply second wax coating following the same process.**]
4. Inspect surface and repair holidays by reheating and applying more wax.
5. Buff waxed surface to a slight shine with a lint-free cloth after wax has cooled to a hazy appearance.

B. Protective Organic Coating: Apply organic coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being coated.
2. Apply two uniform coats by air-spray method according to manufacturer's written instructions, with interim drying between coats.
3. Apply coating to a total dry film thickness of 1 mil (0.025 mm).
4. Protect coated surface from contamination until fully cured.

3.4 PLATING

Identify items and parts of items to be plated or replated on Drawings or in the Historic Decorative Metal Refinishing Schedule; revise requirements for plating to suit Project.

Retain "Shop Plating" or "In-Place Plating" Paragraph, or both, to suit Project; if retaining both, indicate location of each process on Drawings or by inserts. Shop plating generally produces the most uniform results, but removing an item may not be feasible. In-place plating is often used for replating damaged and worn areas and for items that cannot be removed.

A. Shop Plating: Dismantle from substrate each item indicated for shop plating or replating; disassemble item only as necessary for plating process.

1. Clean item to remove dirt, coatings, and corrosion.

2. Fill scratches, cracks, and depressions and polish or texturize metal surface to match the historic metal; prepare metal surfaces for plating.
3. Plate item to match approved mockup; reassemble and reinstall it.

B. In-Place Plating: Protect from damage the materials surrounding and below each item indicated for in-place plating or replating.

1. Clean item to remove dirt, coatings, and corrosion.
2. Fill scratches, cracks, and depressions and polish or texturize metal surface to match the historic metal; prepare metal surfaces for plating.
3. Plate item to match approved mockup.

3.5 DISMANTLING, REPAIR, AND REINSTALLATION

Indicate on Drawings or in the Historic Decorative Metal Refinishing Schedule which decorative metal items are to be dismantled for refinishing or repair and refinishing and reinstalled.

A. Perform dismantling, repair, and reinstallation work as required in Section 024296 "Historic Removal and Dismantling" and Section 050372 "Historic Decorative Metal Repair."

3.6 HISTORIC DECORATIVE METAL REFINISHING SCHEDULE

This schedule demonstrates a method to indicate extensive historic treatment requirements for decorative metal. This schedule is an example only; revise to suit Project and coordinate with historic decorative metal schedules in Section 050371 "Historic Decorative Metal Cleaning" and Section 050372 "Historic Decorative Metal Repair," if retained.

Insert drawing designation and indicate the methods of treatment that apply to the item. Use these designations on Drawings to identify locations.

A. Treatment of Decorative Handrail [**DMR-#**] <**Insert drawing designation**>: Tarnished bronze railing with bronze handrail.

1. Perform work [**in the shop**] [**or**] [**in the field**].
2. Cleaning: [**Water cleaning**] [**Detergent cleaning**] [**Chemical cleaning**] <**Insert description**>.
3. Bronze Finish: [**Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail**] <**Insert requirement**>.

B. Treatment of Decorative Cast-Iron Facade and Storefront [**DMFS-#**] <**Insert drawing designation**>: Repair facade and storefront and replace missing components.

1. Perform work [**in the shop**] [**or**] [**in the field**].

Retain "Dismantle and Salvage Items" Subparagraph below if applicable for specific components of facade and storefront that require salvage; revise to suit Project.

2. Dismantle and Salvage Items: Dismantle the following[**, return to shop to perform indicated treatment of item,**] and deliver to Owner for storage for future installation.

a. Cast-iron medallions.

b. <**Insert item to be salvaged**>.

3. Cleaning: [**Water cleaning**] [**Detergent cleaning**] [**Chemical cleaning**] <**Insert description**>.
4. Paint Removal: [**Alkaline-paste paint remover**] [**Covered or skin-forming alkaline paint remover**] [**Solvent-type paint remover**] [**Low-odor, solvent-type paint remover**] <**Insert method**> as specified in Section 050371 "Historic Decorative Metal Cleaning."
5. Rust Removal: [**Chemical**] [**Mechanical**] <**Insert method**> as specified in Section 050372 "Historic Decorative Metal Repair."
6. Repair: As specified in Section 050372 "Historic Decorative Metal Repair."
7. Finish Treatment:

Retain one or more of "Protective Coating," "Metal Plating," and "Painted Finish" subparagraphs below to suit Project; if retaining more than one, indicate location of each on Drawings or by inserts. Insert other finishes to suit Project.

a. Protective Coating: [**Hot-wax**] [**Organic**] coating.
b. Metal Plating: Plate cast-iron components with [**brass**] [**and**] [**nickel**] <**Insert plating metal**> where indicated on Drawings.
c. Painted Finish: As specified in [**Section 090391 "Historic Treatment of Plain Painting."**] <**Insert Section number and title.**>

C. Treatment of Bronze Statue Finish [**DMS-#**] <**Insert drawing designation**>: Clean, repair [**patina**] [**plated**] finish, and coat statue.

1. Perform work [**in the shop**] [**or**] [**in the field**].
2. Cleaning: [**Water cleaning**] [**Detergent cleaning**] [**Chemical cleaning**] <**Insert description**>.
3. Finish Repair: Selectively [**patinate**] [**plate**] the [**nose**] [**trident**] [**damaged plating**] [**and**] [**previous metal repairs**] <**Insert description**> to match the rest of the statue.
4. Protective Coating: Protective [**hot-wax**] [**organic**] coating.

END OF SECTION 050373

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product certificates.

C. Product test reports.

D. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

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. AllSteel & Gypsum Products, Inc.
2. CEMCO; California Expanded Metal Products Co.
3. Consolidated Fabricators Corp.; Building Products Division.
4. Craco Manufacturing, Inc.
5. MRI Steel Framing, LLC.
6. United Metal Products, Inc.
7. United Steel Deck, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90).

2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 2 inches (51 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips: Manufacturer's standard [bypass] [head] clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by [hot-dip process according to ASTM A 153/A 153M, Class C

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780/A 780M.

B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.
3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

END OF SECTION 054000

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel decorative railings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **professional engineer**.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

C. Preconstruction test reports.

D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: E**ngage** a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made b**y Contractor**. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 STAINLESS STEEL

A. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, **Type 316 or Type 316L**.

B. Bars and Shapes: ASTM A 276, **Type 316 or Type 316L**.

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
   1. Stainless-Steel Components: **Type 316** stainless-steel fasteners.

B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193

2.6 MISCELLANEOUS MATERIALS

A. Wood Rails: Clear, straight-grained hardwood rails secured to **recessed** metal subrail.

   1. Species: White Maple.
   2. Finish: **Transparent polyurethane**.
   3. Staining: None

B. 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.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage **but not less than that required to support structural loads**.

B. Connections: Fabricate railings with **welded** connections unless otherwise indicated.

C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

   1. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.

D. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.8 STAINLESS STEEL FINISHES

A. Dull Satin Finish: ASTM A 480/A 480M, No. 6.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

E. Anchor railing ends to concrete **flanges connected to** railing ends and anchored to wall construction with anchors and bolts.

F. Attach handrails to walls with wall brackets.

1. Use type of bracket with **flange tapped for concealed anchorage to threaded hanger bolt**.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

G. Secure wall brackets to building construction as follows:

1. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

END OF SECTION 057300

SECTION 060312 - HISTORIC WOOD REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood in the form of repairing wood features as follows:

1. Repairing wood paneling, railings, and trim.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 080314 "Historic Treatment of Wood Doors" for historic wood door repairs, including related trim.
3. Section 080352 "Historic Treatment of Wood Windows" for historic wood window repairs, including related trim.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic wood repair and fire protection.
2. Review methods and procedures related to historic wood repair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its location in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood-repair specialist, experienced in repairing, refinishing, and replacing wood in whole and in part. Experience only

in fabricating and installing new woodwork is insufficient experience for wood historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation, Project-site inspection, and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Baseboard Repair: Prepare an approximately 36-inch (1000-mm) length of baseboard to serve as mockup to demonstrate samples of each type of wood repair.

PART 2 - PRODUCTS

2.1 HISTORIC WOOD REPAIR, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grade rules, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 12, Article 1.5, "Industry Practices," of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD ITEMS

A. Replicated Wood Paneling, Railings and Trim: Custom-fabricated replacement wood units and components.
1. Wood Species: Match species of existing wood.
2. Wood Member and Trim Profiles: Match profiles and detail of existing.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

B. Paneling, Railings, and Trim: Match existing species.

C. Exterior Trim: Match existing species.

D. Interior Trim: Match existing species.

2.4 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

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. Abatron, Inc.
    b. ConServ Epoxy LLC.
    c. System Three Resins, Inc.

B. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to featheredge.

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. Abatron, Inc.
    b. ConServ Epoxy LLC.
    c. System Three Resins, Inc.

2.5 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage caused by fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure condition.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

2.6 WOOD FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC WOOD REPAIR, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood-treatment work that is indicated to be completed later.
5. Refinish historic wood according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood by limited replacement matching existing material.

E. Replace Wood: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Identify removed items with numbering system corresponding to item locations, to ensure reinstallation in same location.

3.3 WOOD PATCH-TYPE REPAIR

A. General: Patch wood that exhibits depressions, holes, or similar voids, and that has limited amounts of rotted or decayed wood.

1. Treat wood with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.
2. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood items at locations indicated on Drawings or scheduled.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.

3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Reinstall items removed for repair into original locations.

END OF SECTION 060312

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

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, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. 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 of any species.

B. Other Framing: No. 2 of the following species:

1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Spruce-pine-fir; NLGA.

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. Concealed Boards: 15 percent maximum moisture content of the following species and grades:

1. .Northern species, No. 2 Common grade; NLGA.

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 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

D. Do not splice structural members between supports unless otherwise indicated.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

2. 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.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior wood trim.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

2.2 EXTERIOR TRIM

A. Lumber Trim for Painted Finish:

1. Species and Grade: Eastern white pine, eastern hemlock-balsam fir-tamarack, eastern spruce, or white woods; NeLMA, NLGA, WCLIB, or WWPA D Select (Quality).
2. Maximum Moisture Content: 19 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth).
5. Factory Priming: Factory coated on both faces and all edges, with exterior primer compatible with topcoats specified.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.

1. Cut to required lengths and prime ends.
2. Comply with requirements in Section 099113 "Exterior Painting."

3.2 INSTALLATION, GENERAL

A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/16-inch in 96 inches (1.5 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/32-inch (0.8-mm) maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water.

1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

END OF SECTION 062013

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Shelving.

1.2 DEFINITIONS

A. MDO: Plywood with a medium-density overlay on the face.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's 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, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130>.

E. Particleboard: ANSI A208.1, Grade M-2.

F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

2.2 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: White maple; NHLA Clear.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Not allowed
5. Veneered Material: Not allowed.
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white pine; NeLMA or NLGA C Select.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth).

2.3 SHELVING

A. Exposed Shelving: Made from the following material], 3/4 inch (19 mm) thick:

1. MDO softwood plywood with solid-wood edge.

B. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.

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. A&M Hardware, Inc.
   b. EPCO, Engineered Products Co.
   c. Knape & Vogt Manufacturing Company.

C. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; zinc-plated steel.

D. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; zinc-plated steel.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Low-Emitting Materials: Adhesives shall comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/16-inch in 96 inches (1.5-mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and reveal installation.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.

1. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
2. Stagger joints in adjacent and related standing and running trim.
3. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
4. Use scarf joints for end-to-end joints.
5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.

7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 SHELVING INSTALLATION

A. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches (800 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

B. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches (300 mm) o.c.

C. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. and within 6 inches (150 mm) of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

D. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.

1. Install shelves, fully seated on cleats, brackets, and supports.
2. Fasten shelves to cleats with finish nails or trim screws, set flush.
3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

END OF SECTION 062023

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior ornamental woodwork for opaque finish
2. Wood furring, blocking, shims, and hanging strips for installing ornamental woodwork items that are not concealed within other construction.
3. Shop priming of exterior ornamental woodwork.
4. Shop finishing of exterior ornamental woodwork.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Composite wood products.
2. Finishing materials and processes.
3. Wood-Preservative Treatment:

    a. Include data and warranty from chemical-treatment manufacturer and certification by treating plant that treated materials to comply with requirements.
    b. Indicate type of preservative used and net amount of preservative retained.
    c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
4. Waterborne Treatments: 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. Sustainable Design Submittals:

C. Shop Drawings: Show location of each item, including the following:

1. Dimensioned plans, elevations, and sections.
2. Attachment devices, and other components.
3. Show large-scale details.
4. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
5. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
6. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples: For each exposed product and for each shop-applied color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For ornamental woodwork manufacturer and Installer.

B. Product Certificates: For each type of product.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of each balustrade component and one column section (24” high).
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.7 FIELD CONDITIONS

A. Weather Limitations for Exterior Work: Proceed with installation of exterior ornamental woodwork only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish is to be applied without exposure to rain, snow, or dampness.

PART 2 - PRODUCTS

2.1 ORNAMENTAL WOODWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following

1. Chadsworth Polystone. See Alternates for substitution products.

2.2 ORNAMENTAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of ornamental woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
    a. Contractor shall register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 800-345-0991.

2.3 EXTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

A. Exterior ornamental work for opaque finish includes the following:

1. Balustrades.
2. Columns.
3. Railings

B. Architectural Woodwork Standards Grade: Premium.

C. Wood Species: All-heart redwood or Western red cedar.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

D. Wood Moisture Content: 9 to 15 percent.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel unless otherwise indicated.

B. Nails: ASTM F1667.

C. Power-Driven Fasteners: ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 (ASTM F836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.

G. Postinstalled Anchors: Stainless steel anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing in accordance with ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.

1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or Grade A4).

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, Hanging Strips, and Nailers: Softwood or hardwood lumber kiln dried to less than 15 percent moisture content.

2.6 FABRICATION

A. Fabricate ornamental woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

    a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
    b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

B. Complete fabrication, including assembly and finishing, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

    a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
    b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.7 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing ornamental woodwork, as applicable to each unit of work.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of ornamental woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Exterior Ornamental Woodwork for Opaque Finish: Shop prime all surfaces with one coat of wood primer specified in Section 099113 "Exterior Painting."

2.8 SHOP FINISHING

A. Finish ornamental woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Shop finish transparent-finished ornamental woodwork at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" for field finishing opaque-finished ornamental woodwork.

C. Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" for field finishing ornamental woodwork not indicated to be shop finished.

D. Opaque Finish for Exterior Items: Comply with Section 099113 "Exterior Painting."

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition ornamental woodwork to average prevailing humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing ornamental woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

A. Assemble ornamental woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

B. Install ornamental woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut ornamental woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Preservative-Treated Wood: Where cut or drilled, treat cut ends and drilled holes in accordance with AWPA M4.

E. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor ornamental woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with ornamental woodwork.
3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
4. For shop-finished items, use filler matching finish of items being installed.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064400

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Full tear-off of entire roof system.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.

1.4 FIELD CONDITIONS

A. Existing Roofing System: APP-modified bituminous protected membrane roofing.

B. Owner will not occupy portions of building immediately below reroofing area.

C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

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

1. The results of an analysis of test cores from existing roofing system are available for Contractor's reference.

E. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed to 2,000 lb for rooftop equipment wheel loads and 40 psf for uniformly distributed loads.

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

PART 2 - PRODUCTS

2.1 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

A. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

B. Shut off rooftop utilities and service piping before beginning the Work.

C. Test existing roof drains to verify that they are not blocked or restricted.

1. Immediately notify Architect of any blockages or restrictions.

D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.

1. Prevent debris from entering or blocking roof drains and conductors.

    a. Use roof-drain plugs specifically designed for this purpose.
    b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.

    a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Full Roof Tear-off: Remove existing roofing and other roofing system components down to the existing concrete fill.

1. Remove substrate board, vapor retarder, roof insulation, and cover board.
2. Remove base flashings and counter flashings.
3. Remove perimeter edge flashing.
4. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
5. Remove roof drains indicated on Drawings to be removed.
6. Remove wood blocking, curbs, and nailers.
7. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.

    a. Remove unadhered bitumen, unadhered felts, and wet felts.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.

1. Do not proceed with installation until directed by Architect.

3.4 BASE FLASHING REMOVAL

A. Remove existing base flashings.

1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

END OF SECTION 070150.19

SECTION 072100 - THERMAL INSULATION

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Glass-fiber blanket.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards."

B. Extruded Polystyrene Board, Type VII: ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

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. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

C. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength square edged.

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. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

2.2 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced : 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.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.

END OF SECTION 072100

SECTION 074229 - TERRACOTTA RAINSCREEN CLADDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Terracotta clay panel rainscreen system including the following:
   1. Aluminum clip and sub-girt system.
   2. Extruded single fired double-leaf (terracotta) clay panels.
   3. Flashing, weather-seals, cover plates and decorative metal trim.
   4. Miscellaneous anchors, fasteners, adhesives, insulation, vapor barrier, sealants, and related accessories.

1.2 RELATED SECTIONS

A. Section 05020 - Structural Metal Framing.
B. Section 05400 - Cold Formed Metal Framing.
C. Section 05500 - Metal Fabrications.
D. Section 06100 - Rough Carpentry.
E. Section 07260 - Vapor Retarders.
F. Section 07270 - Air Barriers.
G. Section 07600 - Flashing and Sheet Metal.
H. Section 07900 - Joint Sealers.
K. Section 08925 – Glazed Aluminum Curtain Walls and Sloped Glazing

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM B 221 - Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   3. ASTM C 484 - Standard Test Method for Thermal Shock Resistance of Glazed Ceramic Tile.
   4. ASTM C 1167 - Standard Specification for Clay Roof Tiles.
   5. ASTM E 283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Speciment.
   6. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   7. ASTM E 547 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
   8. ASTM E 782 - Standard Practice for Exposure of Cover Materials for Solar Collectors to Natural Weathering Under Conditions Simulating Operational Mode.
   9. ASTM E 1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
B. National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual for Architectural and Metal Products.
C. American Architectural Manufacturers Association (AAMA): AAMA 508-07 - Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Cleaning methods.

C. Shop Drawings: Complete shop drawings shall be submitted for approval prior to fabrication, with detailed elevations and sections of each condition and application; including metal thickness, finish, methods of installation, anchorage and expansion joints, width, bow, camber, squareness tolerances necessary to accommodate thermal movement and relationship with adjacent construction.

D. Engineering Calculations:
   1. Submit calculations for design of exterior wall system, including deflections, in place stresses, negative pull-off loads and capacity of fasteners.
   2. Calculations shall be signed and sealed by a Professional Engineer registered in the location of the Project.

E. Selection Samples:
   1. Colors and Finishes: Two sets of samples, minimum 8 inches (200 mm) x 4 inches (100 mm), representing manufacturer's full range of available colors and finishes.

F. Verification Samples:
   1. Color and Finish: Two sets of samples, minimum 8 inches (200 mm) x 4 inches (100 mm), representing actual products and finishes specified.
   2. System Components: Two sets of profile samples, minimum 12 inches (300 mm) long.

1.5 PERFORMANCE REQUIREMENTS

A. Description: Provide a complete, pre-engineered aluminum clip and sub-girt system, closure pieces, trim and flashing. The system is to be composed of double-leaf terracotta panels, which can only be removed on purpose, panels hung on aluminum clips at head grooves and base channels and fastened to vertical aluminum sub-frame. The vertical sub-frame is attached to horizontal aluminum “L” profile, which are attached with aluminum clip angles to the structural back-up wall system.

B. Design Criteria:
   1. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within the terracotta rainscreen panel system.
   2. Design system to allow for movements within structure, support loads transferred from the adjacent construction and to fit within the space allotted without projections into the finished space as shown on the Drawings.
   3. The system is to have a continuous aluminum vertical fin with a black silicone spacer between each two panels which will have the following functions:
      a. Keep the uniformed joint dimension and align the panels.
      b. Prevent the panel from rattling.
      c. Integral drainage to direct condensation and minimize water infiltration within the Rainscreen cavity.

1.6 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall have 10 years’ experience manufacturing 40mm thick single fired double-leaf terracotta panels and vertical support system.

2. Terracotta panels and vertical support system are to be provided by the same manufacturer.
3. Manufacturer must have provided 40mm thick double leaf terracotta for over 100 projects totaling at least 500,000 sq ft.

B. Qualifications of Installers:
1. The cladding installer shall be approved by the manufacturer of the terracotta rainscreen system.
2. The installer will have experience with 100,000 sq. ft. of rainscreen installation and 20,000 sq. ft. of terracotta rainscreen installation.
3. For actual installation of cladding, use only competent and skilled mechanics completely familiar with the products and the manufacturer's currently recommended methods of installation.

C. Source Responsibility:
1. The rainscreen system, including the terracotta panels, aluminum sub-structure, and support system, shall be manufactured by the same company.
2. The entire terracotta rainscreen system, with all its components, will have been used at least 10 years and in more than 30 projects.

D. Performance Test Standards:
1. Provide exterior wall system which has been tested and certified by manufacturer to provide specified resistance to air and water infiltration when installed as indicated and when tested in accordance with AAMA 508-07, "Methods of Test for Pressure Equalized Rainscreen Wall Cladding Systems."

1.7 PRECONSTRUCTION TESTING OF TERRA-COTTA PANELS

A. Absorption: Test according to ASTM C 1167 using 24 hour submersion. (separate sets of specimens, minimum 5 specimens each). Absorption by submersion shall not be less than 4 percent or exceed 7 percent average and 8 percent individual specimen.

B. Freezing and Thawing: Test according to ASTM C 1167 for 100 cycles requiring minimum of 50 days minimum 5 specimens). No specimen shall lose more than 3 percent of its original dry weight. No specimen shall crack, crumble or fracture. Specimens shall conform to approved color range samples before and after testing.

C. Modulus of Rupture: Test according to modified ASTM C 1167 67 (minimum 5 specimens) Supports shall be actual hardware used for this project. Apply load at mid-span between supports. Report shall include breaking load, calculated section modules at mid-span, and calculated breaking stress.

D. Acid: Test according DIN EN ISO 10545-13 part 13. No specimen shall have any color change. Minimum 5 specimens from the project specific production shall be tested.

E. Separate sets of specimens are required to be tested for each combination of color and texture. For a given color and texture combination, the most common size panel for the project shall be tested, except for breaking load, where panel size corresponding to maximum span shall be tested. If multiple widths occur to maximum span, test width shall be selected by Architect.

F. Thermal Shock Resistance: Test according to ASTM C 484 for glazed panels. Minimum of 5 specimens. Specimens shall pass one cycle.

G. Mock-Up: Provide a completely assembled, typical wall areas installed with related accessories, in composite configurations designed to fulfill the performance criteria, and representative of the design as shown on the Drawings.
1. Extent of mock-up shall be the same as that which will be provided in the final work.

2. Mock-up shall be installed simulating actual construction conditions, including actual structural supports and connections. Use means, methods and techniques proposed for final installation.
3. Locate mock-up in location as directed by the Architect.
4. Do not proceed with remaining work until workmanship is approved by Architect.
5. Personnel assembling mock-up shall be the same personnel that will perform the actual final units of work at the project site.
6. Mock-up shall be subjected to testing criteria specified for final installation.
7. Mock-up area may become part of finished work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.

B. Store materials in manufacturer's original sealed, labeled packaging until ready for installation and in accordance with manufacturer's instructions. Protect from damage.

1.9 SEQUENCING AND SCHEDULING

A. Pre-Installation Conference: Convene conference prior to start of cladding work, and at Contractor’s direction to review installation procedures and to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Meeting shall include Contractor, Architect, major material manufacturers, and subcontractors whose work needs coordination with cladding work.

1.10 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer’s standard 10 year limited warranty against defects in materials.

B. Installer’s Warranty: Provide Installer’s 2 year installation warranty that exterior wall system will remain weathertight during the warranty period and that if a leak occurs, that the system will be repaired or replaced as required to render the system weathertight, at no cost to the Owner. The installation warranty shall cover labor and materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of design is Shildan, Inc./ Moeding Keramikfassaden GmbH, Germany 40mm double-leaf, single fired terracotta panels c/o 2047 Briggs Road, Mount Laurel, NJ 08054. (215-525-4510)

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 TERRACOTTA CLAY PANEL RAINSCREEN SYSTEMS

A. Exterior Wall Systems: LONGOTON® Terracotta Rainscreen Cladding as manufactured by Shildan, Inc.
   1. Construction: Double leaf clay (terracotta) single fired panel shapes.

2. Minimum single firing temperature of 2,102°F (1,150°C).
3. Panel Thickness: 1-9/16 inch (40 mm) thickness.
4. Size and Configuration: As indicated on the Drawings.
5. Panel Type: Standard.
6. Finish: Standard.
7. Color: TBD

2.3 MATERIALS

A. Double-leaf Single Fired (40mm) Terracotta Panel Units:
   1. Pigmentation: Integral, surface applied color not acceptable.
   2. Tolerances for Terracotta Panels:
      a. Length (axis) 200 to 1800 mm: Tolerance +/- 1 mm
      b. Height (axis) 150 to 600 mm: Tolerance +/- 1.0% within one production, max. 4mm
      c. Thickness 40 mm: Tolerance +/- 2.0 mm.
      d. Longitudinal Bending (in direction of holes): Tolerance +/- 0.5% of length.
      e. Transverse Bending Across Holes: Tolerance +/- 1.0% of height.
      f. Wing Spacing (height of gap at four-point-measurement): Tolerance +/- 0.7% of length + height.
      g. Edge Bending (bend in tile level): Tolerance +/- 0.5% of length of edge.
      h. Angle Difference (left/right of cut ends of tile in direction of holes): Tolerance 90 degrees +/- 0.5%, or 0.5 mm in 100 mm.
   3. Terracotta panels to meet following requirements:
      a. Water Absorption: Test according to ASTM C 1167 using 24-hour submersion (separate sets of specimens, minimum 5 specimens each). Absorption by submersion shall not be less than 4 percent or exceed 7 percent average, 8 percent individual specimen.
      b. Freeze/Thaw: Test according to ASTM C 1167 for 100 cycles. No specimen shall crack, crumble or fracture.
      c. Efflorescence: Test according to ASTM C 1167. Minimum 10 specimens. Specimens to be rated “non-efflorescence”.
      d. Acid: Test according DIN EN ISO 10545-13 part 13. No specimen shall have any color change. Minimum 5 specimens from the project specific production shall be tested.
      e. All glazing materials must not contain lead.
      f. Only terracotta manufacturers who have lead free glazing materials and pass the above acid testing shall be deemed acceptable manufacturers.

B. Fasteners, Clips, and Anchor Channels:
   1. Supplied in accordance with manufacturer’s recommendations to meet load requirements specified.
   2. All fasteners must be stainless steel groups 1, 2 or 3 as designated by the structural calculations.

C. Spacers:
   1. Supplied and installed in accordance with manufacturer’s recommendations.
   2. Only SILICONE gaskets or sealants may be used.

D. Nonferrous Metals:

1. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
2. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

E. Accessories: Corrosion resistant type capable of supporting cladding system and superimposed design loads; design to allow adjustments of system prior to being permanently fastened in place.

F. Finishes, General:
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

G. Aluminum Finishes:
1. The aluminum support system shall have mill finish.
2. All concealed support system components shall be mill finished unless otherwise specified on the drawings.

H. Bituminous Paint: Cold-applied mastic, SSPC Paint 12, compounded for 30 mil thickness per coat.

I. Support System; Fastening Method: A complete, pre-engineered aluminum clip and sub-girt system, complying with the following requirements:
1. The panels are fastened at head grooves and base channels using aluminum clips.
2. The aluminum clips must be fastened to aluminum sub-frame in order to maintain an accurate gap.
3. Panels must be capable of easy and fast assembly.
4. The replacement of damaged panels, particularly in the middle sections, must be possible using simple methods and should not require special tools.
5. Under no circumstances shall it be possible to remove individual panels unless they are first destroyed.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Examine the area, substrates, structural supports, and adjoining construction to receive terracotta panel rainscreen system work and verify:
1. Dimensions of supporting structure by accurate field measurements so that terracotta panel rainscreen system work will be accurately fitted to the structure.
2. Verify dimensions found to be different than shown, including specified tolerances.
3. Correctness of backing, support, and tolerance conditions.
4. That framework is secure and properly aligned and prepared to receive composite panel work.
5. Absence of defects that would adversely affect installation.

B. Do not start work until unsatisfactory conditions are corrected in a manner acceptable to terracotta panel rainscreen system contractor.

C. Prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions.
   1. Supply metal anchors to be built in to other trades for placement. Provide sufficient quantity and direct placement.
   2. Ensure items built in by other trades for this work are properly located and sized.
   3. Establish lines, levels and shims as required. Protect from disturbance.
   4. Do not install broken, chipped or cracked units.

D. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

E. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.2 INSTALLATION

A. Install anchor channels and clips as indicated and in accordance with manufacturer's instructions.
   1. Install sufficient anchorage devices to securely and rigidly fasten system to building. Fasteners to be concealed.
   2. Provide anchors to be installed in other work, and setting details, in time for proper installation by trades concerned; verify correct placement.
   3. Install terracotta panel units on mounting clips.
   4. Assemble and anchor various components to allow for expansion and contraction, maintaining watertight condition.
   5. Ensure assembly is plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.
   6. Allow moisture entering joints and condensation occurring within cavity to drain to exterior.
      a. Design drainage system to hold maximum anticipated moisture for 100 year rain cycle without overflowing.
   7. Apply coat of bituminous paint on concealed aluminum surfaces to be in contact with steel, cementitious, or dissimilar materials.
   8. Set panels in bond pattern indicated on drawings.

B. Tolerances:
   1. Measurements are on the surface exposed to view. The aluminum support system shall not exceed manufacturer's tolerances. Measurements are taken after installation of terracotta panels' aluminum support system, and hardware at project site.
   2. Securely fasten aluminum support system, terracotta panels to building structure and adjust to maintain specified tolerances.

C. Adjusting: Install terracotta clay panels so that in their final location and position, they are not twisted out of plane. Adjust work to conform with the following tolerances (maximum variations):
   1. Face Width of Joints: Plus or minus 1/8 inch (3 mm).
   2. Jog in Alignment of Edge: Plus or minus 1/8 inch (3 mm).

3. Rough Opening Dimension: Plus or minus 1/8 inch (3 mm) at head, plus or minus 1/8 inch (3 mm). at sill, and plus or minus 1/8 inch (3 mm) at jamb.
4. Deviation from Plumb: Plus or minus 1/8 inch (3 mm).
5. Deviation from Horizontal: Plus or minus 1/8 inch (3 mm) maximum in a 20 foot (6 m) run.

D. Built-In Work:
1. As work progresses, build in anchor bolts, flashing and other items supplied by other trades.
2. Install items plumb and true.
3. Do not build in organic materials subject to rot or deterioration.
4. Remove protective film from finished aluminum surfaces.

E. Cutting: When field cutting is undertaken, care shall be exercised to ensure that cuttings do not remain on exposed surfaces.

F. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

G. Perform cutting, drilling, and fitting required to install decorative metal.
1. Erect the Work accurately in location, alignment, and elevation, measured from established lines and levels, free of measurable variations from plumb, level or line.
2. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

H. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

I. Do not cut or abraze finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

J. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

K. Restore protective coverings that have been damaged during shipment or installation.
1. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
2. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude non-uniform oxidation and discoloration.

L. Staining and-or Corrosion Protection:
1. Separate aluminum from direct contact with metals other than stainless steel, zinc, cadmium, or nickel bronze by painting contact surfaces with zinc chromate primer and aluminum paint or with a coat of heavy-bodied bituminous paint or by non-absorptive tape or gasket.

2. Paint exterior aluminum in contact with wood and aluminum in contact with concrete or masonry with zinc chromate primer and aluminum paint or heavy-bodied bituminous paint.

3.3 CLEANING AND PROTECTION

A. Cleaning:
   1. Clean soiled surfaces using materials which will not harm clay panel units or adjacent materials.
   2. Consult clay panel manufacturer to acceptable cleaners. Use non-metallic tools in cleaning operations.
   3. Upon completion of installation, remove protective coatings or coverings and clean aluminum surfaces, exercising care to avoid damage of finish.
   4. Remove excess sealant compounds, dirt or other foreign substances.
   5. Remove and replace clay panel units that are broken, chipped, cracked, abraded or damaged during construction period. Reinstall in accordance with manufacturer's instructions.

B. Protect installed products until completion of project.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Substrate board.
3. Roof insulation.
4. Cover board.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Conference: Conduct conference at Project site.

1.3 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 if insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples: For the following products:

1. Roof membrane and flashings of color required.
2. Aggregate surfacing material in gradation and color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. 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 complying 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.

B. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 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.

1.7 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. Warranty Period: 30 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

D. 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. Fire/Windstorm Classification: Class 1A-120.
2. Hail-Resistance Rating: MH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low]-slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class B; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D 4637/D 4637M, Type II, scrim or fabric internally reinforced, EPDM sheet.

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. Carlisle SynTec Incorporated.
b. Firestone Building Products.
c. International Diamond Systems.
d. Johns Manville; a Berkshire Hathaway company.
e. Roofing Products International, Inc.

2. Thickness: 90 mils (2.2 mm), nominal.

3. Exposed Face Color: Black.

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: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils (1.4 to 1.5 mm) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

F. Bonding Adhesive: Manufacturer's standard.

G. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

H. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

I. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

J. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

K. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

L. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2.4 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength square edged.

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. DiversiFoam Products.
    b. Dow Chemical Company (The).
    c. Owens Corning.

2. Thermal Resistance: R-value of 5.0 perinch (25.4 mm).
3. Size: 48 by 48 inches (1219 by 1219 mm).
4. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: To achieve R48.

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

C. Cover Board: ASTM C 1325, fiber-mat-reinforced cementitious board,7/16-inch (11 mm) thick.

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 minimum concrete drying period recommended by roofing system manufacturer has passed.

2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than as recommended by roofing system manufacturer when tested according to ASTM F 2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m) or portion thereof,of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav 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.

3.3 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm)in adjacent rows.

1. Tightly butt substrate boards together.
2. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.

3.4 INSULATION INSTALLATION

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 insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows.

    a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

c. 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 (610 mm).

1) Trim insulation so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
2) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (305 mm) in adjacent rows.
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 (6 mm) 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 (610 mm).

1) Trim insulation so that water is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    b. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roofing.

3.6 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

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. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

3.7 BASE FLASHING INSTALLATION

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 splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

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.

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed low-slope roof sheet metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: 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.

1.6 WARRANTY

A. Special Warranty on Finishes: 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. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies 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. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Mill phosphatized for field painting.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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. Carlisle Coatings & Waterproofing Inc.
b. Henry Company.

c. Owens Corning.
d. Polyguard Products, Inc.
e. SDP Advanced Polymer Products Inc.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m)minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as 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.

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. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; 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 according to ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: [0.028 inch (0.71 mm) thick.

B. Counterflashing[and Flashing Receivers]: Fabricate from the following materials:

1. Galvanized Steel: [0.028 inch (0.71 mm) thick.

C. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: [0.028 inch (0.71 mm) thick.

D. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: [0.016 inch (0.40 mm)] <Insert dimension> thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

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, solder, 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, levels, and slopes. 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 (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements[, sheet metal manufacturer's written installation instructions,] and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

C. 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 (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm).

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reglets and counterflashings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of roof specialty and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.

1.5 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075323 SF - Ethylene-Propylene-Diene-Monomer (EPDM) Roofing

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 REGLETS AND COUNTERFLASHINGS

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. Castle Metal Products.
2. Cheney Flashing Company.
3. Drexel Metals.
4. Fry Reglet Corporation.
5. Keystone Flashing Company, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Zinc-Coated Steel: Nominal [0.028-inch (0.71-mm) thickness.
2. Corners: Factory mitered and continuously welded.
3. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.2 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

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. Carlisle Coatings & Waterproofing Inc.
    b. GCP Applied Technologies Inc.
    c. Metal-Fab Manufacturing, a Drexel Metals Company.
    d. Owens Corning.

2. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F (116 deg C).
3. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F (29 deg C).

B. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FINISHES

A. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.3 REGLET AND COUNTERFLASHING INSTALLATION

A. Embedded Reglets: See drawings for installation of reglets.

B. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

Retain "Shop Drawings" Paragraph below for work that involves custom fabrication or if manufacturer's Product Data are inadequate.

B. Shop Drawings: For roof accessories.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

Retain "Special Warranty on Painted Finishes" Paragraph below for factory-coated metal. Delete if metal is field finished or left uncoated. Coordinate with finishes retained in Part 2.

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or AVITRU. Before inserting names, verify that manufacturers

and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

2.1 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conn-Fab Sales, Inc.
b. Lloyd Industries, Inc.
c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
d. Roof Products, Inc.
e. Thybar Corporation.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

Retain one of three "Material" paragraphs below. If Project requires more than one material or finish, indicate locations on Drawings or copy paragraph and utilize drawing designations to describe different curb types.

C. Material: Zinc-coated (galvanized) steel sheet, 0.079 inch (2.01 mm) thick.

First option in "Finish" Subparagraph below applies only to zinc-coated (galvanized) steel sheet.

1. Finish: Mill phosphatized.

D. Construction:

Revise subparagraphs below to suit Project and required curb configurations and curb accessories. Insert other features such as counterflashing if required.

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.

Curb height in first subparagraph below may be determined by adding thickness of roof insulation to the minimum base flashing height recommended by roofing membrane manufacturer or established by office practice.

3. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.

4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.

Retain "Liner" Subparagraph below if interior metal liner is required for factory-insulated roof curbs.

7. Liner: Same material as curb, of manufacturer's standard thickness and finish.

Retain "Nailer" Subparagraph below if roofing membrane termination requires use of wood nailer.

8. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.

Retain "Wind Restraint Straps and Base Flange Attachment" Subparagraph below if required by Project wind uplift performance requirements; consult Project structural engineer.

9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.

Retain "Platform Cap" Subparagraph below if required by supported equipment configuration; consult Project HVAC engineer.

10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- (19-mm-) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.2 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed structure-mounting flange at bottom.

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. Conn-Fab Sales, Inc.
    b. Lloyd Industries, Inc.
    c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    d. Roof Products, Inc.
    e. Thybar Corporation.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

Retain one of three "Material" paragraphs below. If Project requires more than one material or finish, indicate locations on Drawings or copy paragraph and utilize drawing designations to describe different curb types.

C. Material: Zinc-coated (galvanized) steel sheet, 0.079 inch (2.01 mm) thick.

First option in "Finish" Subparagraph below applies only to zinc-coated (galvanized) steel sheet.

1. Finish: Mill phosphatized.

D. Construction:

Revise subparagraphs below to suit Project and required equipment support configurations. Insert other features such as counterflashing if required.

1. Curb Profile: Manufacturer's standard compatible with roofing system.

Retain "Insulation" Subparagraph if insulated perimeter-type equipment supports are required to maintain the thermal continuity of low-slope roofing membrane installation. Edit optional insulation thickness if other thickness is required for Project. Material and thickness below is standard; confirm availability of other materials and thicknesses with listed manufacturers.

2. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.

Retain "Liner" Subparagraph below if interior metal liner is required for factory-insulated equipment supports.

3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.

Retain "Nailer" Subparagraph if roofing membrane termination requires use of wood nailer.

4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches (90 mm) wide on top flange of equipment supports, continuous around support perimeter.

Retain "Wind Restraint Straps and Base Flange Attachment" Subparagraph below if required by Project wind uplift performance requirements; consult Project structural engineer.

5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.

Retain "Platform Cap" Subparagraph below if required by supported equipment configuration on perimeter-type supports; consult Project HVAC engineer.

6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- (19-mm-) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.

Equipment-support height in first subparagraph below may be determined by adding thickness of roof insulation to the minimum base flashing height recommended by roofing membrane manufacturer or established by office practice.

9. Fabricate equipment supports to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.3 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

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. AES Industries, Inc.
    b. Architectural Specialties, Inc.
    c. BILCO Company (The).
    d. Custom Solution Roof and Metal Products.
    e. Lexcor; a division of Luxsuco corp.
    f. Metallic Products Corp.
    g. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    h. Nystrom, Inc.
    i. Precision Ladders, LLC.

B. Type and Size: Single-leaf lid, 30 by 96 inches (750 by 2440 mm).

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

D. Hatch Material: Zinc-coated (galvanized) steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.

First option in "Finish" Subparagraph below applies only to zinc-coated (galvanized) steel sheet.

2. Finish: Two-coat fluoropolymer.

Retain "Color" Subparagraph below if retaining either of last two options in "Finish" Subparagraph above.

3. Color: As selected by Architect from manufacturer's full range.

E. Construction:

Retain one material option in "Insulation" Subparagraph below; options are presented in ascending order of cost and thermal resistance; third option for high-performing insulation is available from some of the listed manufacturers.

1. Insulation: 1-inch- (25-mm-) thick, glass-fiber board.

In "R-Value" Subparagraph below, first option corresponds with cellulosic-fiber board insulation, second option corresponds with glass-fiber board insulation, and third option corresponds with polyisocyanurate board insulation specified in "Insulation" Subparagraph above.

a. R-Value: 4.3 according to ASTM C 1363.

Retain "Nailer" Subparagraph below if roofing membrane termination requires use of wood nailer.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.

Retain one of two "Hatch Lid" subparagraphs below; first is more common.

3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.

Retain first "Curb Liner" Subparagraph below if requiring a double-walled curb.

4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

Curb height in first subparagraph below may be determined by adding thickness of roof insulation to the minimum base flashing height recommended by roofing membrane manufacturer or established by office practice.

6. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
7. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
8. Guards: Provide integral guards.

Galvanized-steel hardware in "Hardware" Paragraph below is standard; stainless steel may be available for corrosive environments. Keyed cylinders and high security locking are available from some manufacturers. Verify availability with manufacturers.

F. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

Retain one or both subparagraphs below to suit Project.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).

2.4 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation and mill phosphatized for field painting where indicated.

For field painting specified in Section 099113 "Exterior Painting" retain option in paragraph above, along with first or second subparagraph below.

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2.5 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

Retain one or both "Acrylic Glazing" and "Polycarbonate Glazing" paragraphs below if acrylic or polycarbonate materials are specified for glazing of hatches or heat and smoke vents.

B. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

D. Underlayment:

1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
5. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being

fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

H. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

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.

2.2 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 E 1966 or UL 2079.

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. 3M Fire Protection Products.
b. Hilti, Inc.
c. Thermafiber, Inc.; an Owens Corning company.
d. Tremco, Inc.
e. Willseal LLC.

2. 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. Accessories: Provide components of fire-resistive joint 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 fire-resistive joint 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 fire-resistive joint 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 (150 mm) 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 E 2393.

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 079100 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes preformed, foam joint seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each preformed joint seal product.

B. Samples for Verification: For each type and color of preformed joint seal required.

C. Preformed joint seal schedule.

1.3 WARRANTY

A. Special Warranty: Installer agrees to repair or replace preformed joint seals 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 agrees to furnish preformed joint seals 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 PREFORMED, FOAM JOINT SEALS

A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

1. Design Criteria:

a. Nominal Joint Width: **As indicated on Drawings**.
b. Minimum Joint Width: **As indicated on Drawings**.
c. Maximum Joint Width: **As indicated on Drawings**.

d. Movement Capability: **-25 percent/+25 percent**.

2. Joint Seal Color:**As selected by Architect from full range of industry colors**.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:

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.

B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces.

3.2 INSTALLATION

A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Installation of Preformed, Foam Joint Seals:

1. Install each length of seal immediately after removing protective wrapping.
2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.

4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

END OF SECTION 079100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant 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. Field-adhesion-test reports.

D. Sample warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.6 WARRANTY

A. Special Installer's Warranty: 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 agrees to furnish joint sealants to repair or replace those joint sealants 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 JOINT SEALANTS, GENERAL

A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.4 URETHANE JOINT SEALANTS

A. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.6 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell 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 and the following requirements:

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.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

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.

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 to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. 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.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Joints at the intersection of the Brick wall and Concrete Walk
c. Joints between different materials listed above.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
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.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Control and expansion joints in unit masonry.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in tile flooring.

2. Joint Sealant: Urethane, S, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of unit masonry, concrete, walls, and partitions.

1. Joint Sealant: Urethane, S, P, 50, T, NT.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

2. Joint Sealant: Urethane, S, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 080314 - HISTORIC TREATMENT OF WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood doors in the form of the following:

1. Repairing wood doors and trim.
2. Replacing wood door leaves and frames.
3. Reglazing.
4. Repairing, refinishing, and replacing hardware.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures."

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Door: Generally, this term includes door frame, leaves, hardware, side panels or lights, fan light, transom, storm doors and screen doors unless otherwise indicated by context.

B. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.

C. Interior Trim: Casing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood doors and fire protection.
2. Review methods and procedures related to historic treatment of wood doors.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding door locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified. Approved samples may be incorporated into the Work.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood door specialist, experienced in repairing, refinishing, and replacing wood doors in whole and in part. Experience only in fabricating and installing new wood doors is insufficient experience for wood-door historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Door Repair: Prepare one entire door unit to serve as mockup to demonstrate Samples of each type of repair of wood door members including frame, leaves, glazing, and hardware.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD DOORS, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood doors, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in the "Architectural Woodwork Standards," Section 12, Article 1.5, "Industry Practices," do not apply to the work of this Section.

2.2 REPLICATED WOOD DOOR UNITS

A. Replicated Wood Door Frames and Leaves: Custom-fabricated replacement wood units and trim, with operating and latching hardware.

1. Manufacturer to be a professional member of the Woodwork Institute, The Architectural Woodwork Manufacturers Association of Canada, or the Architectural Woodwork Institute
2. Wood Species: Match wood species of existing exterior door and frame parts.
3. Wood Member and Trim Profiles: Match profiles and detail of existing door members and trim.
4. Hardware: Reuse existing unless otherwise indicated.

5. Hardware Set: Door Hardware Sets according to Section 087100 "Door Hardware."
6. Glazing Stops: Provide replacement glazing stops coordinated with glazing system indicated.
7. Weather Stripping: Full-perimeter weather stripping for each exterior door leaf.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly.

2.4 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated because of weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

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. Abatron, Inc.
b. ConServ Epoxy LLC.
c. System Three Resins, Inc.

B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated because of weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

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. Abatron, Inc.
b. ConServ Epoxy LLC.
c. System Three Resins, Inc.

2.5 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing."

B. Glazing Systems:
1. Modern Glazing Products: Glazing points and single-component polyurethane glazing compound; struck to match taper of existing glazing putty (removed); colored as required to match painted sash.

2. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.6 HARDWARE

A. Primary Door Hardware, General: Provide complete sets of door hardware consisting of hinges, pulls, locks, latches, and accessories indicated for each door or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Door hardware shall smoothly operate, tightly close, and securely lock wood doors and be sized to accommodate frequency of use, glazing weight, and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Match existing material unless otherwise indicated.
2. Design: Custom hardware to replicate existing hardware.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.7 WEATHER STRIPPING

A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when door is closed.

1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.

a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.

2.8 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure conditions.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and door accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.9 WOOD DOOR FINISHES

A. Unfinished Replacement Units: Provide exposed [exterior] [and] [interior] wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood doors of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD DOORS, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood doors to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.

4. Install temporary protective measures to protect wood door work that is indicated to be completed later.
5. Refinish historic wood windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle door hardware; strip paint, repair, and refinish it to match finish Samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood Doors: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood doors by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood doors by limited replacement matching existing material.

E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Protection of Openings: Where doors are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed doors, frames, leaves, and members with numbering system corresponding to door locations to ensure reinstallation in same location.

3.3 WOOD DOOR PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids and that have limited amounts of rotted or decayed wood.

1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.

2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD DOOR MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood door members at locations scheduled and where damage is too extensive to patch.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Glazing: Reglaze units before reinstallation.

1. Mill new and rout existing glazed members to accommodate new glass thickness.
2. Provide replacement glazing stops coordinated with glazing system indicated.
3. Provide glazing stops to match contour of door frames.

E. Reinstall units removed for repair into original openings.

F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter weather stripping for each exterior leaf.

3.5 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing system, and glazing materials, unless more stringent requirements are indicated.

B. Remove existing glass and glazing where indicated in a schedule, and prepare surfaces for reglazing.

C. Remove glass and glazing from openings and prepare surfaces for reglazing.

D. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

E. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

F. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

G. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

H. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 WOOD DOOR UNIT REPLACEMENT

A. General: Replace existing wood door frame and leaf units with new custom-fabricated units to match existing at locations scheduled.

B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Mill glazed members to accommodate glass thickness. Glaze units before installation.

D. Install units level, plumb, square, true to line, without distortion or impeding movement, anchored securely in place to structural support, and in proper relation to wall flashing, trim, and other adjacent construction.

E. Set threshold or sill members in bed of sealant for weathertight construction unless otherwise indicated.

F. Install door units with new anchors into existing openings.

G. Weather Stripping: Install full-perimeter weather stripping for each operable exterior leaf.

H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

END OF SECTION 080314

SECTION 080352 - HISTORIC TREATMENT OF WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood windows in the form of the following:

1. Repairing wood windows and trim.
2. Replacing wood window frames and sash units.
3. Reglazing.
4. Repairing, refinishing, and replacing hardware.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Window: Includes window frame, sash, hardware, trim, storm window, and exterior and interior shutters unless otherwise indicated by context.

B. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.

C. Interior Trim: Casing, stool, and apron.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood windows and fire protection.
2. Review methods and procedures related to historic treatment of wood windows.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding window locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood window specialist, experienced in repairing, refinishing, and replacing wood windows in whole and in part. Experience only in fabricating and installing new wood windows is insufficient experience for wood-window historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Window Repair: Prepare one entire window unit to serve as mockup to demonstrate samples of each type of repair of wood window members including frame, sash, glazing, and hardware.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood windows, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 12, Article 1.5, Industry Practices, of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD WINDOW UNITS

A. Replicated Wood Window Frames and Sash: Custom-fabricated replacement wood units and trim, with operating and latching hardware.

1. Manufacturer to be a professional member of the Woodwork Institute, The Architectural Woodwork Manufacturers Association of Canada, or the Architectural Woodwork Institute
2. Wood Species: Match wood species of exterior window trim and sash parts.

3. Wood Window Members and Trim: Match profiles and detail of existing window members and trim.
4. Glazing Stops: Provide replacement glazing stops coordinated with glazing system indicated.
5. Weather Stripping: Full-perimeter[and meeting rail] weather stripping for each operable sash.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

2.4 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

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. Abatron, Inc.
b. ConServ Epoxy LLC.
c. System Three Resins, Inc.

B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

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. Abatron, Inc.
b. ConServ Epoxy LLC.
c. System Three Resins, Inc.

2.5 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing."

B. Glazing Systems:

1. Modern Glazing Products: Glazing points and single-component polyurethane glazing compound; struck to match taper of existing glazing putty (removed); colored as required to match painted sash.
2. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.6 HARDWARE

A. Window Hardware: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: To match existing unless otherwise indicated.
2. Design: Custom hardware to replicate existing hardware.
3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.7 WEATHER STRIPPING

A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when window is closed.

1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.

a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.

2.8 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.9 WOOD WINDOW FINISHES

A. Unfinished Replacement Units: Provide exposed [exterior] [and] [interior] wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood window work that is indicated to be completed later.
5. Refinish historic wood windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood windows by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood windows by limited replacement matching existing material.
3. Sash Balance: Repair sash balances to function according to type as originally intended. Provide missing sash balances.

E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed windows, frames, sash, and members with numbering system corresponding to window locations to ensure reinstallation in same location.

3.3 WOOD WINDOW PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids, and that have limited amounts of rotted or decayed wood.

1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD WINDOW MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood window members at locations scheduled

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Glazing: Reglaze units before reinstallation.

1. Mill new and rout existing glazed members to accommodate new glass thickness.
2. Provide replacement glazing stops coordinated with glazing system indicated.
3. Provide glazing stops to match contour of sash frames.

E. Reinstall units removed for repair into original openings.

F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.5 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing systems, and glazing materials, unless more stringent requirements are indicated.

B. Remove glass and glazing from openings and prepare surfaces for reglazing.

C. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

D. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

E. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

F. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

G. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 WOOD WINDOW UNIT REPLACEMENT

A. General: Replace existing wood window frame and sash units with new custom-fabricated units to match existing at locations scheduled.

B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Mill glazed members to accommodate glass thickness. Glaze units before installation.

D. Install units level, plumb, square, true to line, without distortion or impeding movement; anchored securely in place to structural support; and in proper relation to wall flashing, trim, and other adjacent construction.

E. Set sill members in bed of sealant for weathertight construction unless otherwise indicated.

F. Install window units with new anchors into existing openings.

G. Weather Stripping: Install full-perimeter and meeting rail weather stripping for each operable sash.

H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

END OF SECTION 080352

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior custom hollow-metal frames.
2. Borrowed lites.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, and wall opening conditions.

C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: 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.

2.2 CUSTOM HOLLOW-METAL FRAMES

A. Interior Frames: NAAMM-HMMA 861. At locations indicated in the Door and Frame Schedule.

1. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
2. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.3 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of [0.053 inch (1.3 mm)] [0.042 inch (1.0 mm)].

B. Construction: Full profile welded.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

C. Power-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials.

D. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite 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 welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. 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.

B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: SDI A250.10.

B. Factory Finish: SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11.

B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
2. Install frames with removable stops located on secure side of opening.

C. Fire-Rated Openings: Install frames according to NFPA 80.

D. Floor Anchors: Secure with postinstalled expansion anchors.

1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

E. Solidly pack mineral-fiber insulation inside frames.

F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

G. 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.

H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

I. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.2 CLEANING AND TOUCHUP

A. 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.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior stile and rail wood doors.
2. Interior stile and rail wood doors.
3. Factory finishing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Details of construction and glazing.
2. Door frame construction.
3. Factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
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. Clearances and undercuts.
6. Requirements for veneer matching.
7. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality control reports.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Door Thermal Transmittance: Maximum whole fenestration product U-factor of 0.30 (1.70) Btu/sq. ft. x h x deg F (W/sq. m x K)>, according to AAMA 1503, ASTM E 1423, or NFRC 100.

2.2 MATERIALS

A. Use only materials that comply with referenced standards and other requirements specified.

1. Assemble exterior doors, including components, with wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.
2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.

B. Panel Products: Any of the following unless otherwise indicated:

1. Hardboard complying with ANSI A135.4.
2. Veneer-core plywood.

C. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

2.3 EXTERIOR AND INTERIOR STILE AND RAIL WOOD DOORS

A. Exterior Stile and Rail Wood Doors: Exterior custom doors complying with the AWI, AWMAC, and WI's Architectural Woodwork Standards, and with other requirements specified.

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. Assa Abloy, Maiman.
b. Eggers Industries.
c. Karona by JELD-WEN.
d. Masonite International, Harring Doors.
e. VT Industries Inc.

2. Performance Grade: WDMA I.S. 6A Extra Heavy Duty.
3. Architectural Woodwork Standards Grade: Custom

4. Panel Designs: As indicated on Drawings.

    a. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.
    b. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

5. Finish: Transparent.
6. Wood Species and Cut for Transparent Finish: White oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels.
7. Door Construction for Transparent Finish:

    a. Stile and Rail Construction: Clear lumber; may be edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.

8. Stile and Rail Widths: As indicated on Drawings.
9. Molding Profile (Sticking): Recessed square.
10. Glass: Uncoated, clear,laminated glass made from two lites of 3.0-mm-thick annealed glass, complying with Section 088000 "Glazing."
11. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.4 STILE AND RAIL WOOD DOOR FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

    1. Clearances:

        a. Provide 1/8 inch (3 mm) at heads, jambs, and between pairs of doors.
        b. Provide 3/8 inch (10 mm) from bottom of door to top of decorative floor finish or covering.
        c. Where threshold is shown on Drawings or scheduled, provide not more than 1/4 inch (6.4 mm) from bottom of door to top of threshold.
        d. Comply with NFPA 80 requirements for fire-rated doors.

    2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

B. Fabricate stile and rail wood doors in sizes indicated for field fitting.

C. 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, BHMA-156.115-W, and hardware templates.
    3. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
    4. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Glazed Openings: Trim openings indicated for glazing with solid-wood moldings, with one side removable. Miter wood moldings at corner joints.

E. Glazed Openings: Factory install glazing in doors, complying with Section 088000 "Glazing." Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C 920. Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

F. Exterior Doors: Factory treat exterior doors with water-repellent preservative after fabrication has been completed but before factory finishing.

1. Comply with WDMA I.S. 4.
2. Flash top of outswinging doors with manufacturer's standard metal flashing.

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.

B. Factory finish doors that are indicated to receive transparent finish.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish: Architectural Woodwork Standards System 10, UV Curable, Water Based.
3. Staining: Match existing door stain.
4. Effect: Open-grain finish to match existing doors.
5. Sheen: Semigloss.

2.6 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. Factory- Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

2.7 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door installations comply with specified requirements.

2.8 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or 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 081433

SECTION 084213 - ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance door systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

C. Samples: For each type of exposed finish required.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, entrance doors, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: As required by design wind velocity, but not less than 10 seconds.

C. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas of entrance doors when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

D. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K as determined in accordance with NFRC 100.
b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F (3.86 W/sq. m x K as determined in accordance with NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.35 as determined in accordance with NFRC 200.
b. Entrance Doors: SHGC of not more than 0.35 as determined in accordance with NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested in accordance with ASTM E283.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m)> at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 70 as determined in accordance with AAMA 1503.
b. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.

E. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.

F. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 ALUMINUM-FRAMED ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

2. Door Design: [Narrow stile; 2-1/8-inch (54-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

4. Door Finish: Superior-performance organic finish.

B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: 1-3/4 by 6 inches (45 by 150 mm.
2. Exterior Framing Construction: Thermally broken.
3. Interior Vestibule Framing Construction: Nonthermal.
4. Finish: Match door finish.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

    a. Sheet and Plate: ASTM B209 (ASTM B209M).
    b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
    c. Structural Profiles: ASTM B308/B308M.

2. Steel Reinforcement:

    a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
    b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
    c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

3. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.7 ALUMINUM FINISHES

A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.3 INSTALLATION OF ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on aluminum-framed entrances.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

C. Aluminum-framed entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 084213

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems.

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: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values for each glazed aluminum curtain wall.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to [1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m)] <Insert deflection limit>.
2. Deflection Parallel to Glazing Plane: Limited to [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm)] <Insert deflection limit>.

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at [150] <Insert number> percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding [0.2] <Insert number> percent of span.
3. Test Durations: As required by design wind velocity, but not less than [10] <Insert number> seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than [6.24 lbf/sq. ft. (300 Pa)] [10 lbf/sq. ft. (480 Pa)] [15 lbf/sq. ft. (720 Pa)] <Insert value>.

G. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than [0.29 Btu/sq. ft. x h x deg F (1.65 W/sq. m x K)] [0.36 Btu/sq. ft. x h x deg F (2.04 W/sq. m x K)] [0.38 Btu/sq. ft. x h x deg F (2.16 W/sq. m x K)] [0.41 Btu/sq.

ft. x h x deg F (2.33 W/sq. m x K)] [0.46 Btu/sq. ft. x h x deg F (2.61 W/sq. m x K)] [0.50 Btu/sq. ft. x h x deg F (2.84 W/sq. m x K)] <Insert value> as determined in accordance with NFRC 100.

2. Solar Heat Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than [0.22] [0.25] [0.26] [0.29] [0.40] [0.45] <Insert value> as determined in accordance with NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than [0.06 cfm/sq. ft. (0.30 L/s per sq. m)] <Insert value> at a static-air-pressure differential of [1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert value> when tested in accordance with ASTM E283.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than [29] [55] [65] [80] <Insert value> as determined in accordance with AAMA 1503.

H. Windborne-Debris Impact Resistance: Pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) above grade.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Superior-performance organic finish.
5. System: stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

C. Glazing Sealants: As recommended by manufacturer.

2.4 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.5 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Provisions for safety railings mounted on interior face of mullions.

7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using [manufacturer's standard assembly method] [shear-block system] [screw-spline system] [head-and-sill-receptor system with shear blocks at intermediate horizontal members] <Insert description>.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 088000 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.6 ALUMINUM FINISHES

A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two tests in areas as directed by Architect.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084413

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum windows for exterior locations.

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: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 60.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of .30.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, 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 joint sealants, 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: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m above grade.

2.2 ALUMINUM WINDOWS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Types: As indicated on Drawings.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

E. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear.
b. Kind: Fully tempered.

2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Pyrolytic on second surface.

F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

C. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.4 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.5 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

1. Color: As selected by Architect from full range of industry colors and color densities.

C. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

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 electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A 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 who is currently certified by DHI as an Architectural Openings Consultant (AOC).

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.

1.8 MAINTENANCE MATERIAL SUBMITTALS.

A. Furnish one exterior and one interior push button door opener that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1 and State of Minnesota Building Code.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3 and referenced on Drawings.

2.3 HINGES

A. Hinges: BHMA A156.1.Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

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. Allegion plc.
b. Baldwin Hardware Corporation.
c. Hager Companies.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.

2. Levers: [Cast].

3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Schlage Commercial Lock Division; Series L, Lever Design 03L.

2.5 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
b. Allegion plc.
c. Hager Companies.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.6 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. DynaLock Corp.
c. Hager Companies.
d. Securitron Magnalock Corporation; an ASSA ABLOY Group company.

2.7 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

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. Arrow USA; an ASSA ABLOY Group company.
    b. Detex Corporation.
    c. Precision Hardware, Inc.; a Stanley company.
    d. SARGENT Manufacturing Company; ASSA ABLOY.

2.8 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
    b. Allegion plc.
    c. Door Controls International, Inc.

2.9 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Von Duprin

2. Reuse existing levers on first floor.

3.

2.10 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable, compatible with BEST.

C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.11 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Master Key System: Change keys and a master key operate cylinders.

a. Provide six master keys.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2.12 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.13 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release[; and with internal override].

2.14 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. LCN 4011/4111

2.15 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.16 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.17 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.18 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.19 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.20 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.21 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: 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. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect.

1. Configuration: Provide one power supply for each door/pair of doors with electrified door hardware.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. 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 will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. 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.

3.3 DOOR HARDWARE SCHEDULE

A. All exposed metal finish for door hardware to be satin stainless steel

B. Hardware Set #1:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin).
2. Electric strike
3. Door contact
4. Automatic door opener/closer
5. Push Button
6. Gasket
7. Exterior threshold
8. Kkickplate at 10”
9. Pull
10. Push bar

C. Hardware Set #2:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin).
2. Electric strike
3. Door contact
4. Closer
5. Gasket
6. Exterior threshold
7. Kickplate at 10”
8. Pull
9. Push bar

D. Hardware Set #3:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin)
2. Automatic door opener/closer
3. Push Button
4. Kickplate at 10”
5. Pull
6. Push bar

E. Hardware Set #4:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin)
2. Closer
3. Kickplate at 10”
4. Pull
5. Push bar

F. Hardware Set #5:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin)
2. Closer
3. Passage lever

G. Hardware Set #6:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin)
2. Closer
3. Privacy lever
4. Occupied Indicator

H. Hardware Set #7:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin)
2. Electric strike
3. Door contact
4. Card Reader
5. Closer
6. Kickplate at 10”
7. Passage lever

I. Hardware Set #8:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin)
2. Electric strike
3. Door contact
4. Card Reader
5. Automatic door opener/closer
6. Pushbutton
7. Kickplate at 10”
8. Passage lever

J. Hardware Set #9:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin).
2. Electric strike
3. Door contact
4. Automatic door opener/closer
5. Push Button
6. Card Reader
7. Gasket
8. Exterior threshold
9. Kkickplate at 10”
10. Pull
11. Push bar

K. Hardware Set #10:

1. 1 ½ pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin).
2. Electric strike

3. Door contact
4. Automatic door opener/closer
5. Push Button
6. Card Reader
7. Gasket
8. Kkickplate at 10”
9. Pull
10. Push bar

L. Hardware Set #11:

1. 2 pr. butt hinges. (Extra heavy stainless steel with ball bearings and non-removable pin).
2. Bar Latch with Hasp Lock, stainless steel, extra heavy duty.

END OF SECTION 087100

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:

1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction test report.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to

manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: [Five] <Insert number> years from date of [Substantial Completion] [manufacture].

PART 2 - PRODUCTS

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. Avalon Glass and Mirror Company.
2. Binswanger Mirror; a division of Vitro America, Inc.
3. National Glass Industries.
4. Trulite Glass & Aluminum Solutions, LLC.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Laminated Mirrors: ASTM C 1172, Type II.

1. Glass for Outer Lite: Annealed float glass, Mirror Select Quality, ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
2. Nominal Thickness for Outer Lite: 3.0 mm.
3. Glass for Inner Lite: Annealed float glass; ASTM C 1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
4. Nominal Thickness: 3.0 m.
5. Interlayer: 0.030-inch- (0.76-mm-) thick, clear polyvinyl-butyral.

C. Safety Glazing Products: For laminated mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating approved by mirror manufacturer.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

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) Andscot Company, Inc.
2) Laurence, C. R. Co., Inc.
3) Stylmark, Inc.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

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) Andscot Company, Inc.
2) Laurence, C. R. Co., Inc.
3) Stylmark, Inc.

b. Finish: Clear satin anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.5 FABRICATION

A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

B. Mirror Edge Treatment: Flat high-polished. Seal edges of mirrors with edge sealer.

C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 090320 - HISTORIC TREATMENT OF PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Repair and replacement of historic interior and exterior lime plaster.
2. Repair and replacement of interior gypsum plaster.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090391 "Historic Treatment of Plain Painting" for paint removal, surface preparation for refinishing, and refinishing of historic plaster surfaces.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of plaster.
2. Review methods and procedures related to historic treatment of plaster and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:
   a. Repair 3 linear ft. (1 m) of plaster cracks.

PART 2 - PRODUCTS

2.1 LIME-PLASTER MATERIALS

A. Hydrated Lime: ASTM C206, Type S or Type N.

B. Lime Putty: Slaked hydrated lime or [actory-prepared lime putty according to ASTM C1489.

C. Sand Aggregates: ASTM C897.

1. Finish-Coat Sand: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. Pigments for Colored Plaster: ASTM C979/C979M and having a record of satisfactory performance in lime plaster.

E. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of natural linen, cotton, hemp, or jute fiber or alkali-resistant glass or polypropylene fiber; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

2.2 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C28/C28M, with mill-mixed perlite aggregate.

2. Gypsum Wood-Fibered Plaster: ASTM C28/C28M.
3. Gypsum Ready-Mixed Finish Plaster: ASTM C28/C28M; manufacturer's standard, mill-mixed, gaged, interior finish.
4. Gypsum Keene's Cement: ASTM C61/C61M.

B. Hydrated Lime: ASTM C206, Type S or Type N.

C. Aggregates:

1. Aggregate for Base-Coat Plasters: ASTM C35, sand.
2. Aggregate for Float Finishes: ASTM C35, sand; graded per ASTM C842.

D. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of natural linen, cotton, hemp, or jute fiber or glass or polypropylene fiber; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

E. Fabric Reinforcing: Coarse, open-weave, alkali-resistant fiberglass or polypropylene fabric; free of grease, waxes, and oils.

F. Bonding Compound: ASTM C631.

2.3 LATH

A. Wood Lath: [1/4 inch by 1-1/4 inch (6 mm by 32 mm)] sound, straight-grained, wood strips.

B. Metal Lath:

1. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet, ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coated.

a. Paper Backing: Kraft paper factory bonded to back of lath.
b. Diamond-Mesh Lath: Flat, 2.5 lb/sq. yd. (1.4 kg/sq. m).
c. Flat Rib Lath: Rib depth of not more than 1/8 inch (3 mm), 2.75 lb/sq. yd. (1.5 kg/sq. m).
d. 3/8-Inch (9.5-mm) Rib Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m).

2.4 TRIM ACCESSORIES

A. General: According to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Cornerite: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
2. Striplath: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.

a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
b. Small nose cornerbead with perforated flanges; use on curved corners.
c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.

d. Bull nose cornerbead, radius of 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.

4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
6. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
7. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:

1. For Lime Plaster: ASTM C1063.
2. For Gypsum Plaster: ASTM C841.
3. For Wood Lath: ASTM C841 requirements for wood-floor-runner or wood-furring fasteners unless otherwise indicated on Drawings.

C. Wire Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Verify that substrate surface conditions are suitable for repairs.
3. Provide lath, furring, and support systems for plaster included in the work of this Section.
4. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
5. Install temporary protective measures to protect historic surfaces that shall be treated later.

B. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.

C. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

D. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

E. Wet wood lath bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

F. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

G. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

H. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.3 FLAT LIME-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster[at locations indicated on Drawings].

B. Lime-Plaster Base Coats:

1. Scratch Coat: 1 part lime putty, 2-1/2 parts base-coat sand, and fiber. Add fiber to mix and evenly distribute it without clumps just before spreading.
2. Brown Coat: 1 part lime putty, 3 parts base-coat sand.

C. Lime-Plaster Finish Coats:

1. Finish-Coat Mix: As required to match finish of design reference sample.

D. Lime-Plaster Finishes: Match finish(es) of design reference sample(s).

E. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair.

3.4 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C842 unless otherwise indicated.

B. Gypsum-Plaster Base Coats:

1. Base Coats over Wood Lath: Gypsum lightweight ready-mixed plaster with fiber.
2. Base Coats over Expanded-Metal Lath: Gypsum neat plaster with job-mixed sand for scratch and brown coats. Add fiber to scratch coat.
3. Base Coats over Expanded-Metal Lath:

    a. Scratch Coat: Gypsum wood-fibered plaster; neat or with job-mixed sand.
    b. Brown Coat: Gypsum wood-fibered plaster with job-mixed sand.

C. Gypsum-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finishes: Gypsum ready-mixed finish plaster.
2. Finish-Coat Mix for Float Finishes: Gypsum gaging plaster.
3. Finish-Coat Mix for Textured Finishes: Gypsum ready-mixed finish plaster.

D. Gypsum-Plaster Finishes: Match finish(es) of design reference sample(s).

3.5 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster.

B. Wood Lath: Install wood lath in same orientation and spacing as remaining wood lath and with lath ends supported by furring or framing. Stagger ends of adjacent laths over different supports, not aligned, and secure with fasteners at each end and spaced a maximum of 24 inches (610 mm) o.c. into supports.

C. Metal Lath: Install according to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster.

3.6 PATCH-TYPE REPAIR

A. General: Patch voids, fractured surfaces, and crushed areas in otherwise sound plaster that are larger than cracks at locations indicated on Drawings.

1. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
2. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
3. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
4. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material.
5. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.

B. Lime-Plaster Mix: Repair mix demonstrated in mockup. Add hair fiber to mix and evenly distribute it without clumps just before spreading.

C. Gypsum-Plaster Mix: Repair mix demonstrated in mockup. Add hair fiber to mix and evenly distribute it without clumps just before spreading.

D. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

E. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

3.7 HAIRLINE CRACK REPAIR

A. General: Repair cracks 1/32 inch (1 mm) in width or narrower in otherwise sound plaster at locations indicated on Drawings.

B. Existing Topcoat: Open crack in existing topcoat to at least 1/8 inch (3 mm) in width and check for broken fiber reinforcement in base coats.

C. Existing Base Coats: Do not open crack wider in existing base coats unless inspection or other indication shows that the fiber reinforcement has broken. Where inspections indicate failure of fiber reinforcement, proceed as for a large crack repair, but only for length of crack with broken fiber reinforcement.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material.

E. Wet substrate to damp condition, but without visible water droplets.

F. Force finish-coat plaster without aggregate into crack, filling crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

3.8 LARGE CRACK REPAIR

A. General: Repair cracks over 1/32 inch (1 mm) in width in otherwise sound plaster at locations indicated on Drawings.

B. Open crack to at least 1/8 inch (3 mm) in width and full depth with V-groove tool, and check for bond separation or lath deterioration.

C. Abrade side surfaces of crack and remove inner crack debris by gouging (keying) the inside area of the crack.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material.

E. Wet substrate to damp condition, but without visible water droplets.

F. Install finish-coat plasterto fill crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

END OF SECTION 090320

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or, the Steel Stud Manufacturers Association].

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C 645.

1. Steel Studs and Tracks:

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) ClarkDietrich.
2) Custom Stud.
3) MRI Steel Framing, LLC.
4) Phillips Manufacturing Co.
5) SCAFCO Steel Stud Company.

b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection
c. Depth: As indicated on Drawings.

C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

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. ClarkDietrich.
b. MRI Steel Framing, LLC.
c. SCAFCO Steel Stud Company.
d. Steel Construction Systems.

2. Minimum Base-Metal Thickness: As indicated on Drawings.
3. Depth: As indicated on Drawings.

D. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

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. ClarkDietrich.
b. MRI Steel Framing, LLC.
c. SCAFCO Steel Stud Company.
d. Steel Construction Systems.

2. Configuration: Asymmetrical or hat shaped.

E. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

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. ClarkDietrich.
b. MRI Steel Framing, LLC.
c. SCAFCO Steel Stud Company.
d. Steel Construction Systems.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.

a. Uses: Securing hangers to structure.
b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
c. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks: ASTM C 645.

    a. Minimum Base-Metal Thickness: As indicated on Drawings
    b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.

    a. Minimum Base-Metal Thickness: As indicated on Drawings.

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

    a. Configuration: Asymmetrical or hat shaped.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced [24 inches (610 mm)o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.

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 Corporation.

c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

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 Corporation.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

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 Corporation.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

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 Corporation.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.

3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, 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 Corporation.
    c. Georgia-Pacific Gypsum LLC.
    d. National Gypsum Company.
    e. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized-steel sheet.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.
    g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

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.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. 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.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

2.8 Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.

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. Pyrok, Inc.

2. Application Thickness: 25 mm.
3. 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.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

4. NRC: 0.55 according to ASTM C 423.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C 840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) 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.

D. 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.

E. Prefill open joints, rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. 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 4: At panel surfaces that will be exposed to view.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

I. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

J. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.2 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quarry tile.
2. Porcelain tile.
3. Tile backing panels.
4. Waterproof membrane.
5. Crack isolation membrane.
6. Metal edge strips.

1.2 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. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
3. Stone thresholds.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 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.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

B. 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 mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

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.

2.2 TILE PRODUCTS

A. Ceramic Tile Type - CT-1: Unglazed square-edged quarry tile.

1. Summitville Extruded Quarry Tile
2. Face Size: 4 by 6 inches (102 by 152 mm).
3. Thickness: 1/2 inch (12.7 mm).
4. Wearing Surface: Nonabrasive, smooth.
5. Dynamic Coefficient of Friction: Not less than 0.42.
6. Tile Color and Pattern: #48 Moroccan Brown – color batch 543. Match existing.
7. Grout Color: As selected by Architect from manufacturer's full range to match existing.

B. Ceramic Tile Type [PCT-1]: Porcelain floor and wall tile.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. American Olean; a division of Dal-Tile Corporation.

2. Module Size: 12 x 24
3. Face Size Variation: Rectified.
4. Thickness: 5/16 inch (8 mm).
5. Face: Plain with modified square edges.
6. Finish: Bright, opaque glaze.
7. Tile Color and Pattern: Concrete Chic, Current Cream
8. Grout Color: As selected by Architect from manufacturer's full range.
9. Mounting: Factory, back mounted.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
1. Thickness: 5/8 inch (15.9 mm).

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

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. ARDEX Americas.
b. Bostik, Inc.
c. MAPEI Corporation.

2.5 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

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. C-Cure.
c. MAPEI Corporation.

2.6 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

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. Bonsal American, an Oldcastle company.
b. Bostik, Inc.
c. C-Cure.
d. MAPEI Corporation.

e. Summitville Tiles, Inc.

2. For wall applications, provide nonsagging mortar.

C. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARDEX Americas.
b. Bonsal American, an Oldcastle company.
c. MAPEI Corporation.

2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
4. For wall applications, provide nonsagging mortar.

2.7 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARDEX Americas.
b. Bonsal American, an Oldcastle company.
c. Bostik, Inc.
d. H.B. Fuller Construction Products Inc. / TEC.
e. MAPEI Corporation.
f. Summitville Tiles, Inc.

2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
3. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

2.8 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.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; [stainless-steel, ASTM A 666, 300 Series exposed-edge material.

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. Blanke Corporation.

b. Ceramic Tool Company, Inc.
c. Schluter Systems L.P.

C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Summitville SL-55 Summitseal II.

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.
2. Verify that concrete substrates for tile floors installed with [adhesives] [bonded mortar bed] [or] [thinset mortar] comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

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. Exterior tile floors.
    b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.

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. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. 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.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)].
2. Quarry Tile: [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)].
3. Pressed Floor Tile: [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)].
4. Glazed Wall Tile: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)].
5. Porcelain Tile: [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)].

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. 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.

J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

K. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

L. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

M. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F111 and ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane.

    a. Ceramic Tile Type: CT1 and PCT1
    b. Bond Coat for Cured-Bed Method: Standard dry-set mortar.
    c. Grout: High-performance sanded for CT1 and High-performance unsanded for PCT1.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation TCNA W221 and ANSI A108.1C; cement mortar bed (thickset) over cleavage membrane on solid backing.

    a. Ceramic Tile Type: PCT 1.
    b. Bond Coat for Wet-Set Method: Improved modified dry-set mortar.
    c. Bond Coat for Cured-Bed Method: Improved modified dry-set mortar.
    d. Grout: High-performance unsanded grout.

END OF SECTION 093013

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 MAINTENANCE MATERIAL SUBMITTALS.

A. Furnish 5 percent extra materials, from the same product run for each type, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILES

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. Armstrong World Industries, Inc.

B. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264.

C. Classification: Calla.

D. Color: White

E. Edge/Joint Detail: Square, kerfed, and rabbeted; tongue and grooved; or butt

F. Thickness: As indicated in a schedule

G. Modular Size: As indicated in a schedule.

2.2 METAL SUSPENSION SYSTEM

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. Armstrong World Industries, Inc.

B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, fully concealed, metal suspension system that complies with applicable requirements in ASTM C 635/C 635M.

C. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.

1. Structural Classification: Heavy-duty system.
2. Access: Upward and end pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.
3. Silhouette XL 1/8” Reveal Tee System

2.3 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.4 METAL EDGE MOLDINGS AND TRIM

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. Armstrong World Industries, Inc.

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 complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples: For each exposed product and for each color and texture specified.

1.3 MAINTENANCE MATERIAL SUBMITTALS.

A. Furnish 5 percent extra materials, from the same product run for each type, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Johnsonite; a Tarkett company.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style B, Cove: As noted in schedule.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Cut lengths 48 inches (1219 mm) long.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: 29 – Moonrock.

2.2 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 manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

END OF SECTION 096513

SECTION 096516.13 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Linoleum floor tile.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

C. Samples: In manufacturer's standard size, but not less than 6-by-9-inch (152-by-230-mm) sections of each color and pattern of floor covering required.

D. Maintenance data.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor coverings.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 72 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the following:

1. Forbo Flooring, Inc.; MCT 3084, Graphite

2.2 LINOLEUM FLOOR COVERING

A. Floor Tile: ASTM F 2195, Type I, linoleum floor tile with fibrous backing.

1. Nominal Floor Tile Size: Manufacturer's standard.

B. Thickness: Manufacturer's standard.

C. Colors and Patterns: MCT 3084, Graphite

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.

1. Use adhesives that have a VOC content of not more than [50 g/L] <Insert requirement> when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor coverings until they are same temperature as space where they are to be installed.

1. Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for installing floor coverings.

B. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

C. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on subfloor. Use chalk or other nonpermanent marking device.

E. Adhere floor coverings 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.

3.3 LINOLEUM FLOOR TILE INSTALLATION

A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor 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 floor tiles square with room axis

B. Match floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles with grain running in one direction.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying liquid floor polish.

1. Apply three coat(s).

C. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Substantial Completion.

END OF SECTION 096516.13

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Pattern of installation.
4. Pattern type, location, and direction.
5. Pile direction.
6. Type, color, and location of insets and borders.
7. Type, color, and location of edge, transition, and other accessory strips.
8. Transition details to other flooring materials.

C. Samples: For each exposed product and for each color and texture required.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.6 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 Period: 10 years from date of Substantial Completion.

1.7 MAINTENANCE MATERIAL SUBMITTALS.

A. Furnish 5 percent extra materials, from the same product run for each type and size, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Interface, LLC.
2. Shaw Contract Group; a Berkshire Hathaway company.

B. Color: As Scheduled on A601.

C. Pattern: As Scheduled on A601.

D. Size: As Scheduled on A601.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standards" 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 (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) 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 CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns As Scheduled on A601.

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.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

J. 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

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on following exterior substrates:

1. Wood.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish 1 gal. (3.8 L) that match each material and color applied and identified with intact labels describing contents.

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. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As indicated in a color 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 the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. 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 CLEANING AND PROTECTION

A. 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.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Wood Substrates: Wood trim, door trim, and window trim.

1. High-Performance Architectural Latex System MPI INT 6.3A:

a. Prime Coat: Primer, latex for exterior wood, MPI #39.

1) Sherwin Williams Primer

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #139.

1) Sherwin Williams

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Steel and iron.
2. Wood.
3. Gypsum board.
4. Plaster.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish 1 gal. (3.8 L) that match each material and color applied and identified with intact labels describing contents.

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. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide product listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As indicated in a color schedule.

1. Ten percent of surface area will be painted with deep tones.

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. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.
2. Gypsum Board: 12 percent.
3. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. 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 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. High-Performance Architectural Latex System MPI INT 5.1RR:

    a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

        1) Sherwin Williams Primer

    b. Prime Coat: Shop primer specified in Section where substrate is specified.
    c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    d. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

        1) Sherwin Williams

B. Wood Substrates: Wood trim, Doors Trim, and Window Trim.

1. High-Performance Architectural Latex System MPI INT 6.3A:

    a. Prime Coat: Primer, latex, for interior wood, MPI #39.

        1) Sherwin Williams Primer

    b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

    c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

        1) Sherwin Williams

    d. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

        1) Sherwin Williams

C. Gypsum Board and Plaster Substrates:

1. High-Performance Architectural Latex System MPI INT 9.2B:

    a. Prime Coat: Primer sealer, latex, interior, MPI #50.

        1) Sherwin Williams Primer

    b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

        1) Sherwin Williams

    d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) Sherwin Williams

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of transparent finishes on the following substrates:

1. Interior Substrates:

a. Dressed lumber (finish carpentry or woodwork).

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of finish system and in each color and gloss of finish required.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish 1 gal. (3.8 L) that match each material and color applied and identified with intact labels describing contents.

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. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide product listed in wood finish systems schedules for the product category indicated.

2.2 MATERIALS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Stain Colors: As selected by Architect from manufacturer's full range.

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. Maximum Moisture Content of Interior Wood Substrates: 9 percent, when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish 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 hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, 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 finished wood surfaces.

3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

A. Wood Substrates: Wood trim, architectural woodwork, and doors.

1. Water-Based Varnish over Stain System MPI INT 6.3W:

    a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

        1) Sherwin Williams

    b. First Intermediate Coat: Water-based varnish matching topcoat.
    c. Second Intermediate Coat: Water-based varnish matching topcoat.
    d. Topcoat: Varnish, water based, clear, satin MPI Gloss Level 4, MPI #128.

        1) Sherwin Williams

END OF SECTION 099300

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For 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 other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Cast Characters on A434: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

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. A.R.K. Ramos.
b. ACE Sign Systems, Inc.
c. Gemini Incorporated.
d. Metal Arts.
e. Metallic Arts.

2. Character Material: Cast aluminum.
3. Character Height: As indicated on Drawings.
4. Finishes:
a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

5. Mounting: Projecting studs.

2.2 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish nonferrous-metal devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.3 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

PART 3 - EXECUTION

3.1 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. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. 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. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for each exposed product and for each color and texture specified.

D. Product certificates.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

PART 2 - PRODUCTS

2.1 PHENOLIC-CORE UNITS

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. Accurate Partitions Corporation.
2. American Sanitary Partition Corporation.
3. Ampco, Inc.
4. Bobrick Washroom Equipment, Inc.
5. Bradley Corporation; Mills Partitions.
6. Flush Metal Partition Corp.
7. General Partitions Mfg. Corp.
8. Global Steel Products Corp.

9. Knickerbocker Partition Corporation.
10. Metpar Corp.
11. Partition Systems Incorporated of South Carolina.
12. Rockville Partitions Incorporated.
13. Sanymetal; a Crane Plumbing company.
14. Shanahan's Limited.
15. Tex-Lam Manufacturing, Inc.
16. Weis-Robart Partitions, Inc.
17. Young Group Ltd. (The); Fabricated Products Division; DesignRite Partitions.

B. Toilet-Enclosure Style: Floor anchored.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges.. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

E. Pilaster Shoes: Fabricated from stainless-steel sheet, not less than 3 inches (76 mm) high, finished to match hardware.

F. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; aluminum.

G. Phenolic-Panel Finish: Facing sheet of one color and pattern in each room.

1. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard through-color core matching face sheet.

2.2 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Clear-anodized aluminum.
2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

B. Clearances: Maximum 1/2 inch (13 mm) between pilasters and panels; 1 inch (25 mm) between panels and walls.

C. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Warm-air dryers.
3. Childcare accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Full size, for each exposed product and for each finish specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish one extra hand dryer and one towel dispenser that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser: As scheduled on A603

B. Combination Towel (Folded) Dispenser/Waste Receptacle: As scheduled on A603

C. Liquid-Soap Dispenser: By Owner

D. Grab Bar: As scheduled on A603

E. Sanitary-Napkin Disposal Unit: As scheduled on A603.

F. Mirror Unit: As scheduled on A603

G. Coat Hook: As scheduled on A603

2.3 WARM-AIR DRYERS

A. Warm-Air Dryer: As scheduled on A603.

B. Diaper-Changing Station: As scheduled on A603.

2.4 FABRICATION

A. 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 (1112 N), when tested according to ASTM F 446.

END OF SECTION 102800

SECTION 142150 - GEARLESS MACHINE-ROOM-LESS TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard pre-engineered elevator systems and as required for a complete system. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevators as herein specified.

Section Includes: Gearless Machine-Room-Less (MRL) Traction elevators as follows:

1. One (1) Passenger Elevator, Car PE1

B. Products Installed but Not Furnished Under This Section:
1. Emergency Voice/Alarm Communication System Provisions
2. Car flooring

C. Related Sections:

1. 03 30 00 Cast-in-Place Concrete
2. 04 20 00 Unit Masonry
3. 09 00 00 Finishes
4. 21 00 00 General Requirements for Fire Suppression
5. 23 00 10 Mechanical General Conditions
6. 25 00 00 Building Automation and Control
7. 26 00 10 Electrical General Conditions
8. 26 05 00 Common Work Results for Electrical
9. 27 30 00 Voice Communications
10. 28 31 11 Digital, Addressable Fire Alarm System

D. The stipulated design criteria and parameters specified herein are intended as a guide to the overall design, construction, and materials required and should not be construed as an engineered design. These stipulations do not cover all necessary features to ensure satisfactory, AHJ approved operation and do not absolve the Contractor of their requirement to provide an elevator system that complies with applicable code, and is smooth, quiet, durable and efficient, while providing economy of maintenance.

1.2 ALLOWANCES

A. Elevator Car Allowances: Provide $10,000 and 1,000 lbs. weight allowance per elevator for an interior finish allowance for the passenger elevators. The allowances include furnishing and installing the following items:
1. Car wall finishes, including trim
2. Car ceiling, including lighting, wring, and coordination of battery-operated emergency lighting
3. Car door, transom and return finishes

4. Handrails
5. Car subfloor and fastening
6. Mounting for protective pads
7. Protective pads
8. Assistance of IUEC approved installers.

1.3 APPLICABLE CODES

A. Performed work will comply with the following Federal, State and Municipal codes applicable at time of Contract execution, as determined by the Authority Having Jurisdiction (AHJ), or by the most stringent code applicable. Compliance with these codes, including alternates, interpretations or modifications, are the responsibility of the Contractor.

1. ASME: Safety Code for Elevators and Escalators, A17.1
2. ASME: Guide for Inspection of Elevators, Escalators and Moving Walks Inspectors Manual A17.2, A17.5, A17.6, A17.7
3. ANSI: Accessible and Usable Buildings and Facilities A117.1
4. IBC: International Building Code
5. NEC: National Electrical Code
6. NFPA: NFPA 101 Life Safety Code
7. NFPA: National Fire Alarm and Signaling Code
8. ADA: Standards for Accessible Design
9. Local and State laws applicable to project location

1.4 REFERENCE STANDARDS

1. ANSI: American National Standards Institute.
2. ASTM: American Society for Testing and Material.
3. AWS: American Welding Society.
4. IEEE: Institute of Electronic and Electrical Engineers.
5. NEMA: National Electrical Manufacturers Association.
6. NFPA 70: National Fire Protection Association.
7. NBS: National Bureau of Standards.
8. OSHA: Occupational Safety and Health Administration.
9. UL: Underwriters Laboratories.

1.5 DEFINITIONS

A. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

B. Technical definitions as defined in ASME A17.1, AHJ adopted edition.

C. Terms:

1. "Provide": To supply, install, connect and make ready for safe and normal operation the complete elevator system as specified herein.
2. "Install": To erect, mount, and connect complete with related accessories.
3. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

4. "Work": Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.
5. "Wiring": Conduit, fittings, wire, traveling cables, junction and outlet boxes, switches, cutouts, receptacles, related items and accessories.
6. "Similar" or "Equal": Approved material, weight, size, design, and characteristics to the specified product.
7. "Approved", "Satisfactory", "Accepted", or "Directed": As approved, satisfactory, accepted or directed by or to the Owner.
8. "Owner": Shall be defined as person or company holding title to property in which this specified work is to be performed or his appointed representative(s).
9. "Contractor": Shall be defined as the elevator company performing the work described in these specifications.
10. “Architect”: MacDonald and Mack
11. “Consultant”: Elevator Advisory Group

1.6 DOCUMENT VERIFICATION

A. In order to discover and resolve conflicts or lack of definition which may impede the project outcome, the elevator manufacturer must review contract documents for compatibility with its product prior to bidding. This includes a thorough review of the elevator, architectural, structural electrical, mechanical and low voltage documents.

B. Submit specific, written exceptions and/or clarifications with quotation. Compliance with provisions of contract documents is assumed and required in the absence of a written exception.

C. Owner will not pay for change to related work systems required to accommodate manufacturer’s equipment if not identified before Contract Award.

D. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication, or erection methods, or techniques provided design intent is maintained, as determined by the Owner, Architect and /or Consultant. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.7 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.

B. Shop Drawings. Provide electronic copies of the following:

1. Fixture and signaling shop drawings
2. Cab layout detailing finishes, dimensions and assembly
3. Detailed cut sheets highlighting coordination with building structure (MEP and Structural reactions)
4. Machine room, control room and hoistway plans and sections
5. Power data including electrical starting/ running currents and heat loads
6. Cut sheets for security and remote monitoring provisions

It is understood that approval of the drawings and cut sheets by the Owner, Architect or Consultant shall be for general arrangement only and do not include measurement verification which remains the responsibility of the Contractor, as does the verification of actual conditions against the Contract Documents.

C. Samples. Provide:

1. 3” square samples of cab finishes

D. Maintenance Data.

Prior to Final Acceptance, provide four (2) sets of bound instructions and three (3) sets of instructions in electronic format, which include:

1. Service manuals that include written information necessary for proper maintenance and adjustment of the equipment, including testing procedures and troubleshooting.
2. As-built controller straight line diagrams
3. Lubricating instructions
4. Parts catalogue

E. Diagnostic Test Equipment and Instructions: Provide all diagnostic test devices together with one set of all supporting information necessary for interpretation of test data and troubleshooting of system. The elevator installation shall be a design that can be maintainable by any licensed elevator maintenance company employing journeymen mechanics, without the need to purchase or lease additional diagnostic devices, special tools, or instructions from the original equipment manufacturer.

1.8 PERMITS AND TESTING

A. Make application for, secure and pay for all necessary permits and certificates of inspection for all equipment included herein, as required by the various departments of the Local and State Authorities. Furnish the Owner with permits and certificates while also providing laminated copies in the respective machine rooms or closets.

B. Any damage of any kind to the car or the adjoining structure which may develop through performance of any tests or inspections shall be repaired at no additional costs to the Owner.

1.9 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications: Manufacturer with not less than 10 years experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years and with sufficient production capability, facilities, and personnel to produce required Work.

B. Supervision: Installer shall maintain a competent supervisor who is at project site during times specified Work is in progress and who is experienced in installing systems similar to type and scope required for project.

C. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

1.10 PATENTS

A. Contractor agrees to defend, and hold harmless, the Owner, Architect, and Consultant, and agents and employees thereof, from any liability due to patent infringement from performing the work as detailed in the Contract Documents.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

B. Failures include, but are not limited to: operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

C. Warranty Period: One year from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall provide twelve months full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Perform maintenance during normal working hours.
   2. Perform emergency callback service during normal working hours Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of sixty minutes or less.

B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard three-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 ELEVATORS

A. Gearless MRL Passenger Elevator Description:
   1. Elevator Identification: Car PE1
   2. Capacity: 3500 lbs.
   3. Class of Loading: Class A
   4. Contract Speed: 200 fpm
   5. Machine: Gearless

6. Machine Location: Overhead machine room less
7. Controller Location: In jamb
8. Counterweight Location: Side
9. Stops: 1 Front, 4 Rear
10. Travel: 32’ 10”
11. Openings: 1 Front (1), 4 Rear (-1, 2-4)
12. Minimum Clear to underside of canopy: 8’ High
13. Entrance Size: 3'-6" Wide X 7' High
14. Entrance Type: Single side opening
15. Door Operation: Medium speed, heavy duty
16. Aluminum with extensions
17. Signal Fixtures: recessed stainless steel, vandal resistant
18. Lanterns: cab jamb
19. Stretcher Compatible: Yes
20. Hoist Beam: May need to be removed after install due to hoistway height restrictions

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Otis Elevator Company
   2. ThyssenKrupp Elevator
   3. KONE
   4. Schindler

B. Approved Components:
   1. Fixtures vandal-resistant.

2.3 MATERIALS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard pre-engineered elevator systems and as required for a complete system. Omit all logos from exposed surfaces.

B. Inserts: Furnish required concrete inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.

C. Machine Beams: If necessary, provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Structural Steel Framing" for materials and fabrication. Coordinate with General Contractor.

D. Electrical Wiring:

   1. Provide 10% spare wires between each controller, selector, hoistway junction box, and control panel; also provide 10% spare conductors in each travel cable; all spares shall be properly tagged or otherwise identified with clear and indelible markings.
   2. Provide a total of twelve (12), 20 gauge shielded pairs for communication and security use in the traveling cables for each elevator. The shielded pairs shall be located in a cable

which is not used to carry alternating current circuits. The shielded wiring shall extend to a junction box in the elevator controllers in machine room.

E. Steel:
   1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
   2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
   3. Structural Steel Shapes and Plates: ASTM A36.

F. Stainless Steel: Type 302 or 304 complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
   1. No. 4 Satin: Directional polish finish. Graining directions as shown or, if not shown, in longest dimension.
   2. No. 8 Mirror: Reflective polish finish with no visible graining.
   3. Textured: .050 inches mean pattern depth with bright directional polish (No. 4 satin finish).
      a. 2WL or 5WL as manufactured by Rigidized Metals.
      b. 5-SM as manufactured by Rimex Metals.
   4. Burnished: Non-directional, random abrasion pattern.

G. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209.

H. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±.005" thick, color and texture as follows:
   1. Exposed Surfaces: Color and texture selected by Architect.
   2. Concealed Surfaces: Manufacturer's standard color and finish.

I. Fire-Retardant Treated Particle Board Panels: Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing; meet ASTM E84 Class "I" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.

J. Natural Finish Wood Veneer: Standard thickness, 1/40" thoroughly dried conforming to ASME/HPMA HP-1983, Premium Grade. Place veneer, tapeless spliced with grain running in direction shown, belt, and polish sanded, book-matched.
   1. Species and Finish: As shown on Drawings.

K. Paint Finishes, General: Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer. Galvanized metal need not be painted.
   1. Prime Finish: Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.

L. Baked Enamel Finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.

M. Tile: Refer to Section 09310, Vinyl Composition Tile.

N. Paint. Provide:

1. Two (2) coats of rust inhibiting paint on all exposed or non painted metals in the machine room and hoistway.
2. Two (2) coats of enamel paint on the machine room floors.
3. Two (2) coats of vinyl white paint on the machine room walls

2.4 CAR PERFORMANCE

A. Speed Control: Suitable for operation specified and capable of providing smooth, comfortable car acceleration, and dynamic braking. Limit the difference in car speed between full load and no load to not more than +/-3% of the contract speed.

B. Car Capacity: Safely lower, stop and hold 125% of rated load.

C. Automatic Stopping Zone: Stop car within 1/4" above or below the landing sill. Avoid over travel/ under travel, and maintain stopping accuracy regardless of load in car, direction of travel, or distance between landings, rope slippage or stretch.

2.5 OPERATION

A. Selective Collective Microprocessor-Based, PE1:
1. Operate car without attendant from pushbuttons in car and at each floor. When car is available, automatically start car, and dispatch it to floor corresponding to registered car or hall call. Once car starts, respond to registered calls in direction of travel and in the order the floors are reached.
2. Reverse car direction only when all car calls have been answered, or all hall and car calls ahead of car and corresponding to the direction of car travel have been answered.
3. Slow car and stop automatically at floors corresponding to registered calls, in the order in which they are approached in direction of travel. As slowdown is initiated for a hall call, automatically cancel hall call. Cancel car calls in the same manner. Hold car at arrival floor an adjustable time interval to allow passenger transfer.
4. Answer calls corresponding to direction in which car is traveling unless call in the opposite direction is highest (or lowest) call registered.
5. Illuminate appropriate pushbutton to indicate call registration. Extinguish light when call is answered.

B. Other Items:
1. Load Weighing: Provide means via cable tension monitors for weighing car passenger load. Control system to provide dispatching at main floor in advance of normal intervals when car fills to capacity. Provide hall call by-pass when the car is filled to preset percentage of rated capacity and traveling in down direction. Field adjustment range: 10% to 100%.
2. Anti-Nuisance Feature: If car loading relative to weight in car is not commensurate with number of registered car calls, or activation of door protection device is not commensurate with number of registered car calls, cancel car calls.

C. Car-to-Lobby Feature: Provide the means in the main hall pushbutton station for automatic return to the recall floor. Return car nonstop after answering pre-registered car calls, and park with doors open for an adjustable time period of 60-90 seconds. Upon expiration of time period, car shall

automatically revert to normal operation and close doors until assigned as next car or until the car is placed on independent service.

D. Firefighters' Service: Provide equipment and operation in accordance with code requirements.

E. Motion Control: Microprocessor-based AC variable-voltage, variable frequency with digitally encoded closed-loop velocity feedback suitable for operation specified and capable of providing smooth, comfortable car acceleration, retardation, and dynamic braking. Limit the difference in car speed between full load and no load to not more than ±3% of the contract speed.

F. Standby Lighting and Alarm: Car mounted battery unit with solid-state charger to operate alarm bell and car emergency lighting. Battery to be rechargeable with minimum five-year life expectancy. Provide constant pressure test button in service compartment of car operating panel. Provide lighting integral with portion of normal car lighting system.

G. Door Operation: Automatically open doors when car arrives at main floor. At expiration of normal dwell time, close doors. Provide front or rear selective door operation.

H. Standby Lighting and Alarm: Car mounted battery unit with solid-state charger to operate alarm.

I. Battery Automatic Rescue Operation: Upon loss of normal power automatically lower or raise the car to the nearest landing depending on the load in the car. Upon arrival at the landing, the elevator doors shall open automatically and remain open until regular door time has expired. The elevator shall then be removed from service. The auxiliary power source shall be provided via 12-volt D.C. battery units installed in machine space. Include solid-state charger and testing means mounted in a common metal container. Battery to be rechargeable lead acid or nickel cadmium with a ten-year life expectancy. Upon restoration of normal power, the elevator shall automatically resume normal operation.

2.6 EQUIPMENT SPACE

A. Arrange equipment in spaces shown on drawings.

B. Traction Hoist Machine:
   1. AC induction ACV³F gearless traction type motor with brakes, drive sheave, and deflector sheave mounted in proper alignment on a common, isolated bedplate.
   2. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.

C. Encoder: Direct drive, solid-state, digital type. Update car position at each floor and automatically restore after power loss.

D. Controller: UL/CSA labeled. Locate in door jamb at top floor.
   1. Compartment: Securely mount all assemblies, power supplies, chassis switches, relays, etc., on a substantial, self-supporting steel frame. Completely enclose equipment with covers. Provide means to prevent overheating.
   2. Wiring: CSA labeled copper for factory wiring. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
   3. Permanently mark components (relays, fuses, PC boards, etc.) with symbols shown on wiring diagrams.

E. Machine and Equipment Support Beams: Rail supported by Elevator contractor
   1. Provide bearing plates, anchors, shelf angles, blocking, embedment, etc., for support and fastening of machine beams or equipment to the building structure.
   2. Isolate machine and overhead sheave beams to prevent noise and vibration transmission to building structure.

F. Governor: Centrifugal-type, car driven located in control space with pull-through jaws and bi-directional shutdown switches. Provide required bracketing and supports for attachment to building structure. Provide ladders and platforms with handrails and toeboards for governor access. Provide remote reset capability.

G. Emergency Brake:
   1. Provide means to prevent ascending car over-speed and unintended car movement per Code.

2.7 HOISTWAY EQUIPMENT

A. Guide Rails: Planed steel T-sections for car and counterweight of suitable size and weight for the application. Provide rail backing and intermediate counterweight tie brackets. Provide bracketing, at top and bottom of floor beams. No additional structural points of attachment other than those shown on the Contract Documents will be provided.
   1. Provide any additional structural steel or supports to achieve code-required rail deflection limits, as required by manufacturer's design and system. Provide intermediate structural supports as required for manufacturer's design and system. No additional structural points of attachment other than those shown on the Contract Documents will be provided

B. Buffers: Oil type with blocking and support channels.

C. Equipment Access: Provide buffer access ladders and platforms. Stencil car number on buffer.

D. Sheaves: Machined grooves and sealed bearings. Provide mounting to machine beams, machine bedplate, car and counterweight structural members, or building structure.

E. Counterweight: Steel frame with metal filler weights.

F. Counterweight Guide Shoes: solid guides with oilless inserts.

G. Governor Rope and Encoder Tape Tensioning Sheaves: Mount sheaves and support frame on pit floor or guide rail. Provide frame with guides or pivot point to enable free vertical movement and proper tension of rope and tape.

H. Suspension Means:
   1. 8 x 19 or 8 x 25 Seale construction, traction steel type. Fasten with staggered length, adjustable, spring isolated wedge type shackles.
   2. Coated, flat belt with imbedded steel cables.
   3. Approved governor rope.

I. Terminal Stopping: Provide normal and final devices. Provide emergency terminal speed limiting devices.

J. Electrical Wiring and Wiring Connections:
   1. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes. Provide 10% spare conductors throughout. Run spare wires from car connection points to individual elevator controllers in the equipment space.
   2. Conduit: Galvanized steel conduit, EMT, or duct. Flexible conduit length not to exceed 3'-0". Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
   3. Traveling Cables: Flame and moisture-resistant outer cover. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
      a. Provide five pair of shielded wires of minimum 18-gauge for card reader.
      b. Provide eight pair of spare shielded communication wires in addition to those required to connect specified items.
      c. Tag spares in equipment space. Provide cables from controller to car top.
   4. Auxiliary Wiring: Provide conduit, wiring and connections for fire alarm initiating devices, emergency two-way communication system,and announcement speaker equipment space junction box to each car controller in equipment space.

K. Entrance Equipment:
   1. Door Hangers: Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.
   2. Door Tracks: Bar or formed, cold-drawn removable steel tracks with smooth roller contact surface.
   3. Door Interlocks: Operable without retiring cam. Paint interlock box flat black.
   4. Door Closers: Spring, spirator, or jamb/strut mounted counterweight type. Design and adjust to insure smooth, quiet mechanical close of doors.

L. Floor Numbers: Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors and hoistway fascia visible from within car.

2.8 HOISTWAY ENTRANCES

A. Complete entrances bearing fire labels from a certified testing laboratory approved by authority having jurisdiction.

B. Frames: 14-gauge hollow metal at all floors. Bolted and lapped head to jamb assembly at all floors. Provide Arabic floor designation/Braille plates, centered at 60" above finished floor, on both side jambs of all entrances. Provide plates at main egress landing with “Star” designation. For designated emergency car, provide “Star of Life” cast designation plates at height of 78"-84" above finished floor on both side jambs at all floors. Braille indications shall be below Arabic floor designation. Provide cast floor designation/Braille plates as manufactured by SCS Elevator Products, Inc. with permanent rear fasteners.

C. Door Panels: 16-gauge steel, formed construction without binder angles. Provide leading edges of center-opening doors with rubber astragals. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel. Construct door panels with interlocking, stiffening ribs.

D. Sight Guards: 14-gauge, same material and finish as hoistway entrance door panels. Construct without sharp edges.

E. Sills: Extruded aluminum.

F. Sill Supports: Structural or formed steel designed to support door sill based upon car loading classification. Mount to eliminate need for grout under the sill.

G. Fascia, Toe Guards and Hanger Covers: 14-gauge furniture steel with Contractor's standard finish.

H. Struts and Headers: Provide all support of entrances and related material to building structure. Provide door open bumpers on entrances equipped with vertical struts.

I. Elevator Identification Signage: Provide alpha-numerical car label at designated floor. Provide metal plate, finish to match designated fixture finish.

J. Finish of Frames and Doors: Satin finish stainless steel. Provide final painting requirements to General Contractor where factory prime finish is specified.

K. Hoistway Access:
   1. Hoistway Door Unlocking Device: Provide unlocking device with locking escutcheon in door panel at all floors, with finish to match adjacent surface.
   2. Hoistway Access Switches: Mount in entrance frame side jamb at top and bottom floors. Provide switch faceplate.

2.9 CAR EQUIPMENT

A. Frame: Welded or bolted, rolled or formed steel channel construction to meet load classification specified.

B. Safety Device: Type "B," flexible guide clamp.

C. Platform: Isolated type, constructed of steel, or steel and wood that is fireproofed on underside. Design and construct to accommodate load classification requirements. Provide Class "A" construction for passenger elevators.

D. Platform Apron: Minimum 14-gauge steel, reinforced and braced to car platform front and rear with Manufacturer's standard finish.

E. Guide Shoes: Roller type with three or more spring dampened, sound-deadening rollers per shoe.

F. Finish Floor Covering: Furnished under other sections.
   1. Passenger Car: Accommodate a minimum 1" tile floor thickness.

G. Sills: One-piece aluminum extrusion with extruded extension between car entrance columns to face of car front return. Extruded extension to match finish of sill.

H. Door Panels: 16-gauge steel, formed construction without binder angles. Provide leading edges of center-opening doors with rubber astragals. Provide a minimum of two gibs per panel, one at

leading and one at trailing edge with gibs in the sill groove entire length of door travel. Construct door panels with interlocking, stiffening ribs.

I. Door Hangers: Two-point suspension. Hanger roller with non-metallic surface and eccentric roller adjustment.

J. Door Track: Bar or formed, cold-drawn removable steel track with smooth roller contact surface.

K. Door Header: Construct of minimum 12-gauge steel, shape to provide stiffening flanges.

L. Door Electrical Contact: Prohibit car operation unless car door is closed. Provide car door interlock to prevent opening of car doors outside the unlocking zone.

M. Door Clutch: Heavy-duty clutch, linkage arms, vane assembly and pickup rollers or cams to provide positive, smooth, quiet door operation. Design clutch so car doors can be closed, with hoistway doors open.

N. Restricted Opening Device: Provide mechanical car-door restrictor to prevent opening of doors when outside unlocking zone.

O. Door Operator: High speed, heavy-duty door operator capable of opening doors at no less than 2.5 f.p.s. Accomplish reversal in no more than 2½" of door movement. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current. Provide a minimum of four controller-based motion profiles, per floor, per door, to maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or varying air pressure.

P. Door Reversing Device:
   1. Infrared Reopening Device:
      a. Black fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 7'-0" above finished floor. Device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation. In event of device failure, provide for automatic shutdown of car at floor level with doors open.
   2. Nudging Operation: After beams of door control device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), warning signal shall sound and doors shall attempt to close with a maximum of 2.5 foot-pounds kinetic energy. Activation of the door open button shall override nudging operation and reopen doors.
   3. Interrupted Beam Time: When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
   4. Differential Door Time: Provide separately adjustable timers to vary time that doors remain open after stopping in response to calls.
      a. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
      b. Hall Call: Hold open time adjustable between 5.0 and 8.0 seconds. Use hall call time when car responds to coincidental calls.

Q. Car Operating Panel- Main and auxiliary:

1. ‘No Smoking’ engraving
2. Engraved elevator number
3. Emergency light
4. Firefighter Hat jewel
5. Firefighters cabinet (Keys FEOK-1’S). To include:
    a. Hat
    b. Call cancel
    c. Door open
    d. Door close
    e. Run/ Stop
    f. Two (2) spares
6. 1/8” high vandal resistant SS buttons with halo
7. Door open
8. Door close
9. Alarm button
10. “Help” button, with ‘when lit help is on its way’ engraving
11. Hands free emergency two way phone with speaker pattern
12. Attendants Cabinet. To include:
    a. Light keyswitch, on/ off
    b. Fan keyswitch, off/ low/ high
    c. Access enable, on/ off
    d. Inspection, on/ off
    e. Cab overload jewel
    f. Emergency light test button
    g. GFCI
    h. Two spares
13. Capacity engraving
14. Certification window

R. Car Top Control Station: Mount to provide safe access and utilization while standing on car top.

S. Work Light and Duplex Plug Receptacle: GFCI protected outlet at top and bottom of car. Include on/off switch and lamp guard.

T. Communication System:
    1. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in equipment space. Provide dialer with automatic rollover capability with minimum two numbers.
        a. Actuate two-way communication via “Help” button.
        b. Button or adjacent light jewel shall illuminate and flash when call is acknowledged.
        c. Button shall match car operating panel pushbutton design.
        d. Provide “Help” button tactile symbol, engraved signage, and Braille adjacent to button mounted integral with car front return panel.
    2. Provide two-way communication between car and equipment space if required.

2.10 CAR ENCLOSURE

A. Passenger Elevator: Provide complete as specified herein and reference allowance section.
    1. Shell: Reinforced furniture steel formed panels with baked enamel interior finish as selected. Apply sound-deadening mastic to exterior. Provide concealed ventilation cutouts.
    2. Canopy: Reinforced furniture steel formed panels with lockable, contacted, hinged emergency exit. Interior finish white reflective baked enamel.
    3. Front and Rear Return Panels: Reinforced furniture satin stainless steel with minimum with cutouts for applied car operating panels and other equipment.

4. Transom: Reinforced furniture steel clad with minimum satin stainless steel full width of enclosure.
5. Car Door Panels: Reinforced minimum furniture satin stainless steel. Same construction as hoistway door panels.
6. Base: Stainless steel with concealed ventilation cutouts.
7. Interior Wall Finish: Include allowance of $10,000 and 1000 lbs. for interior car finishes.
8. Lighting: Provide LED fixtures with wiring and hookup. Coordinate with emergency lighting requirements.
9. Suspended Ceiling: Six-section satin finish stainless steel panels with lighting cutouts in each panel.
10. Handrails: Minimum 1¼" diameter aluminum tubular grab bar with backing plates and captive nuts across side walls. Bolt rails through car walls from back and mount on 1½" deep solid round stainless steel standoff spacers no more than 18" O.C. Return handrail/guardrail ends to car walls.
11. Pads and Buttons: Three-piece removable pads. Two pads covering side walls and adjacent front returns and one covering rear wall. Provide cutouts to access main car operating panel.

2.11 HALL CONTROL STATIONS

A. Pushbuttons: Provide two risers with flush mounted faceplates. Include pushbuttons for each direction of travel that illuminate to indicate call registration. Include approved engraved message and pictorial representation prohibiting use of elevator during fire or other emergency on separate engraved plate. Pushbutton design shall match car operating panel pushbuttons. Provide vandal resistant pushbutton and light assemblies. Provide LED illumination.

B. Phase I Fire Service fixture, including keyswitch, engraved operating instructions and illuminating jewel..

C. Provide buttons integral with hall control station. Pushbutton design shall match car operating panel pushbuttons.

2.12 SIGNALS

A. Car Direction Lantern:
1. Provide at each entrance to indicate travel direction of arriving car. Locate as detailed on architectural drawings.
2. Illuminate up or down LED lights and sound tone once for up and twice for down direction. Illuminate light until the car doors start to close and as doors open.
3. Sound level shall be adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
4. Car direction lenses shall be arrow shaped with faceplates.
5. Lenses shall be minimum 2½" in their smallest dimension.

B. Car Position Indicator: Alpha-numeric digital indicator containing floor designations and direction arrows a minimum of 1/2" high to indicate floor served and direction of car travel. Locate fixture in car front return panels. When a car leaves or passes a floor, illuminate indication representing position of car in hoistway. Illuminate proper direction arrow to indicate direction of travel.

C. Faceplate Material and Finish: Satin finish stainless steel, all fixtures. Tamper resistant fasteners for all fastenings exposed to the public.

D. Floor Passing Tone: Provide an audible tone of no less than 20 decibels and frequency of no higher than 1500 Hz, to sound as the car passes or stops at a floor served.

E. Firefighters' Key Box: Flush-mounted box with lockable hinged cover. Engrave instructions for use on cover per Local Fire Authority requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to beginning installation of equipment examine hoistway and equipment space areas to verify elevator system design requirements have been met.

B. It is the Contractor's responsibility to coordinate installation of sleeves, block outs, elevator equipment with integral anchors, machine beam, and other items that are embedded or placed on concrete or masonry needed for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, machine beams, and installation instructions and deliver to Project site in time for installation.

C. It is also the responsibility of the Contractor to coordinate the integration of the elevator systems with the other building trades, including, but not limited to: pit ladders; sumps; floor drains; entrance sills; electrical service, outlets, lights, and switches; beams; HVAC positioning; smoke detector positioning, car reader, and security provisions

D. Provide all required staging, protection, hoisting, hoist/safety beams, and equipment necessary for the movement of equipment. It can be assumed that storage space at the site will be limited. If any additional off site space is required, the cost is the responsibility of the Contractor.

E. Do not proceed with installation until work in place conforms to project requirements.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in Contractor's original unopened protective packaging.

B. Store material in original protective packaging. Prevent soiling, physical damage, or moisture damage.

C. Protect equipment and exposed finishes from damage and stains during transportation and construction.

3.3 INSTALLATION

A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.

B. Install equipment space equipment with clearances in accordance with referenced codes and specification.

C. Install all equipment so it may be easily removed for maintenance and repair.

D. Provide any required hoisting/safety beams. Remove if beams are encroaching on code clearances prior to final acceptance.

E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.

F. Remove oil, grease, scale, and other foreign matter from all equipment and apply one coat of field-applied machinery enamel for all equipment and metal work installed that does not have a factory applied paint or architectural finish. Neatly touch up damaged factory-painted surfaces with original paint color to protect factory finished surfaces against corrosion.

G. Fill hoistway door frames, back boxes for hallway stations and signal devices, and sills.

H. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

C. Independent Testing by Owner’s Consultant:

3.5 ERECTION TOLERANCES

A. Install rails plumb and align vertically with tolerance of 1/16" in 100'-0". Secure joints without gaps and file any irregularities to a smooth surface.

3.6 ADJUSTING

A. Static balance car to equalize pressure of guide shoes on guide rails. Dynamically balance car and counterweight.

B. Lubricate all equipment in accordance with Contractor’s instructions.

C. Adjust motors, power conversion units, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve specified performance levels.

3.7 CLEANING

A. Keep work areas orderly and free from debris during progress of project. Remove packaging materials on a daily basis.

B. Remove all loose materials and filings resulting from work.

C. Clean equipment space equipment and floor.

D. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.

E. Clean pit equipment and floor.

3.8 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevators.

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.9 PROTECTION

A. The elevators shall not be used for construction purposes without authorization from the Owner. Should the elevators be authorized for temporary use, the following conditions shall apply:

1. The Contractor shall provide a temporary acceptance form for the user to sign.
2. Neither the warranty or maintenance period shall start at this time unless specifically approved in writing by the Owner.
3. The user shall provide, if job conditions require, all temporary enclosures, guards or other protection of all installed equipment.
4. The user shall return the elevators in the same condition they were in when placed on temporary service and shall pay the Elevator Contractor for maintenance, repairs or clean up.
5. The cost of temporary service shall not be charged to the Owner.

B. As elevators are completed, the Owner shall have the prerogative of accepting and using them, shutting them down, or accepting them under an Interim Service Agreement described below:

1. The Owner shall have the prerogative of continuing the Interim Service Agreement until all elevators in the group (or building) are completed.
2. The warranty period will start at the termination of the Interim Service Agreement period.
3. The cost of Interim Service shall not exceed the prorated cost of the monthly maintenance bid required by these specifications.

C. Temporary Use: with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.

INDEX TO SPECIFICATIONS

END OF INDEX

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 WORK INCLUDES

A. Furnishing labor, materials, equipment and services required for the complete installation of new plumbing systems shown on the Drawings and specified in Division 22.

B. All work to be complete and to be left in operating condition.

C. Include all parts and labor, which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents.

D. Some equipment and materials provided under Division 22, 23, 25 or Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 22, 23, 25 and Division 26 Contract Documents to determine where these composite crews are required.

E. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project. Pay all fees and costs charged by utility companies for utility services.

F. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.

G. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.

H. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.

I. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

J. Furnish labor, equipment, and materials required for cutting, demolition, removal, patching, and restoration work necessary to accomplish and complete all demolition, including any relocation or reuse of existing materials, equipment, systems, as well as the disposition of salvaged materials or debris.

1.2 RELATED SECTIONS:

A. General Provisions are specifically applicable to all Division 22 Sections.

B. Divisions 0 and 1 apply to all work of Division 22 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 22 05 00 takes precedence. Section 22 05 00 specifies conditions, procedures, equipment and material particular to the mechanical work and applies to all mechanical work of the Contract Documents.

C. Division 0 and 1 and Section 22 05 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 22 work. Copy these documents to all Sub-contractors receiving other Sections of Division 22.

D. Where a Specification Section refers to other Sections under the Article on "Related Sections", this is done for Contractor's convenience only. It in no way relieves the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.3 WORK SEQUENCE

A. Coordinate all work of this Section with General Contractor and all subcontractors so the work will progress without interruption and without delays.

B. Coordinate and schedule the work with the Owner and Construction Manager where possible disturbance may occur or where relocations or other potential disruptions of the Owner's functions and services are required. Perform all work affecting the Owner's functions and services at times acceptable to the Owner, even if this requires the Contractor to do the work in stages as directed by the Owner and Construction Manager.

1.4 ALTERNATES

A. Alternates: Refer to Bid Form and Instruction to Bidders.

1.5 REGULATORY REQUIREMENTS

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

Americans with Disabilities Act
Municipal Water and Sewer Regulations
National Electric Code
NFPA 101 Life Safety Code
Occupational Safety and Health Administration Regulations
State and Local Building Codes
State and Local Electrical Codes
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State and Local Plumbing Codes
State Industrial Commission Regulations
State Elevator Code
State Energy Code
Uniform Federal Accessibility Standards
AIA Guidelines
NFPA 99 Health Care Facilities

1.6 REFERENCES

A. Use the Standard where referenced in the specifications by the following abbreviations:

AIA - American Institute of Architects
ANSI - American National Standards Institute
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society of Testing and Materials
AWWA - American Water Works Association
EPA - Environmental Protection Agency
FM - Factory Mutual
IEEE - Institute of Electrical and Electronic Engineers

IES - Illuminating Engineering Society of North America
ICEA - International Cable Engineers Association
IRI - Industrial Risk Insurance
NEBB - National Environmental Balancing Bureau
NBFU - National Bureau of Fire Underwriters
NBS - National Bureau of Standards
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NSC - National Safety Council
OSHA - Occupational Safety and Health Administration
PDI - Plumbing and Drainage Institute
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
UL - Underwriter's Laboratories

1.7 DEFINITIONS

A. Contract Documents: References to Contract Documents refers to a complete set of Drawings and Specifications for the entire Project. Drawings and Specifications are intended to supplement one another. Provide items shown on the Drawings but not mentioned in the Specifications and items mentioned but not shown the same as if they were both mentioned and shown. Bid the most expensive interpretation of a conflict between Drawings and Specifications so the conflict can be resolved with a deduct rather than an add to the contract amount.

B. Dimensions: Arrangement of equipment, accessories, piping and ductwork on the Drawings is generally diagrammatic unless the Drawings include dimensions. Do not scale the Drawings. Field verify all dimensions at the site to locate new and existing work.

C. Furnish: To obtain, coordinate, submit the necessary drawings, deliver to the job site in new condition ready for installation, unload and unpack, and guarantee.

D. Install: To receive at the job site, store, assemble, erect, set in place, anchor, apply, finish, protect, clean, test, start-up, and make ready for Owner’s use.

E. Provide: To furnish and install.

F. Responsibility: Where verbs such as “furnish”, “provide”, “install”, or “use” appear in the Contract Documents, they mean, “The Mechanical Contractor to furnish, provide, install, or use…..” unless the requirement is introduced by a phrase, sentence or heading specifically identifying the requirement as the responsibility of someone else.

1.8 SUBMITTALS

A. Substitutions

1. Submit written requests to use products not listed in the Specifications to the Engineer no later than ten (10) calendar days prior to the bid opening. Requests must be submitted by a bidding Contractor. Submit detailed information for proposed material or equipment.

2. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.

3. Contractor is responsible for dimensional differences, weights, electrical requirements and any other resulting changes, when using equipment other than that scheduled on the Drawings. Contractor is responsible for any additional costs incurred as a result of substitutions, including other Contractors and Architect/Engineer fees.

4. Material and equipment not listed in the Specifications or accepted in an Addendum shall be removed and replaced at no cost or inconvenience to the Owner.

B. List of Materials, Equipment and Sub-Contractors

1. Submit a complete list of all materials, equipment, and sub-contractors, proposed to be used on this project, to the Engineer within seven (7) calendar days of the award of contract or written notice to proceed.
2. Acceptance of items on the list are considered final, unless additional information or submissions are required by the Engineer. Unacceptable items will be rejected and resubmitted.

C. Pay Request Cost Breakdown

1. Provide Schedule of Values for the utilization of submitting a "Pay Request". Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.
2. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or as requested by the Engineer.
   a. Basic Materials and Methods
   b. Building Service Piping
   c. Plumbing Fixtures and Equipment
   d. Testing, Adjusting and Balancing

D. Submittals for Review

1. Submit in accordance with Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.
2. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacturer, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned without review.
3. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.
4. Submit PDF of each set of shop drawings based off of specification sections to the Architect & Engineer. Red lined PDF shall be returned to the Architect, Construction Manager or General Contractor - (two copies to be incorporated into the O&M Manuals.
5. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.
6. Submittals will be reviewed with the following actions:
   a. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.
   b. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.

c. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.

d. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.

7. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.

8. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.

9. Submit shop drawings for the following equipment and systems:

Section	Description
22 05 16	Common Motor Requirements for Plumbing Equipment
22 05 19	Gages and Meters for Plumbing Piping
22 05 23	General Duty Valves for Plumbing and Natural Gas Piping
22 05 29	Hangers and Supports for Plumbing Piping and Equipment
22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
22 05 53	Identification for Plumbing Piping and Equipment
22 07 19	Plumbing Piping Insulation
22 11 16	Domestic Water Piping
22 11 19	Domestic Water Piping Specialties
22 13 16	Sanitary Waste and Vent Piping
22 13 19	Sanitary Waste Piping Specialties
22 14 29	Sump Pumps
22 42 00	Commercial Plumbing Fixtures

1.9 CAD/REVIT DRAWING FILES

A. The mechanical CAD/Revit drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD/Revit drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.10 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.

C. Accomplish all work of cutting, removal, demolition, relocation, patching, and restoration by using only mechanics skilled in the trade required. Provide for the safety of the existing building and personnel, as well as for new construction as a result of work, procedures, operations or activities under this Contract.

D. Where the work of removals, demolition, cutting and similar work involves structural considerations, consult with Engineer. Exercise extreme care to avoid damage and preserve the safety of the structure and of all personnel. Particular care must be taken where the demolition or removals occur adjacent to occupied areas.

E. Utilize competent and qualified technical assistance to develop safe methods and techniques to accomplish the work, including temporary shoring and supports, methods of removal and other considerations. Design and place all permanent or temporary supports to carry all loads down to sound bearing.

1.11 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.

2. Mechanical equipment and systems shown on the drawings as existing, have been based on existing plans, and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of Division 26 and other trades for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that can not be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.

2. Drawings may not show every rise and offset required for the work. Install piping and ductwork to accommodate the building structure and the work of other trades, with all required offsets and without extra cost to the Owner.

3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.

4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor to make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.

5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.

6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and Specifications are complementary and what is called for in either is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the Drawings and Specifications.

1.12 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specified in other Sections.

1.13 ELECTRICAL

A. Magnetic starters, disconnects, and power wiring provided by the Electrical Contractor, unless otherwise specified.

B. Control and interlock wiring provided by the Mechanical Contractor, unless otherwise specified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S, VENDORS, SUPPLIERS OR AGENTS

A. Provide only products and services from manufacturers, vendors, suppliers or agencies with local representation and listed in these specifications that can provide complete coverage, parts and labor, for replacement and service of their products and listed in these specifications. Provide only equipment that will fit in the space available and be completely serviceable. Bring any conflicts to the Engineer's attention prior to ordering the equipment. Wholesale suppliers are not considered manufacturer representative unless they can provide the services listed in these specifications.

2.2 DEMOLITION

A. Remove salvageable materials and other items designated for reuse or relocation by the applicable trades and relocated to the new location.

B. If the new location is not ready to receive the relocated materials, store and protect from damage until they can be incorporated into the new work.

C. If the Owner is unable to forego the use of any existing items at the normal time for relocation, make all preparations for that work and then delay relocation until a time approved by the Owner or until other facilities are available to the Owner.

D. Carefully remove, clean, salvage and preserve all materials indicated to be reused, or which will be needed for reuse to match existing work.

E. Exercise extreme care in removals to prevent damage which would make materials unsuitable for reuse.

F. Replace all damaged materials, which were shown, tagged or needed for reuse, with equivalent.

2.3 SALVAGEABLE MATERIALS TO BE STORED BY OWNER

A. The Owner will mark or tag existing materials, equipment or other items he wishes to retain.

B. Carefully remove salvageable materials and items designated or marked to remain the property of the Owner. Protected from damage and store adjacent to the removal area as directed.

C. Consult the Owner about any salvage he may wish to retain and about the salvageability of all items. Carefully remove and salvage any materials the Owner wishes to retain.

D. Cleaning or restoration of the Owner's salvaged materials is not a part of this contract.

E. Relocate salvage material from the area and the site to the Owner's storage.

2.4 UNSALVAGEABLE MATERIALS

A. Remove all unsalvageable materials in a manner that will avoid damage to materials or equipment which will remain. Completely remove from the site as approved by and scheduled with the Owner.

B. Legally dispose of all unsalvageable materials away from the site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Continuity of Service:

1. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.

2. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

3. No fire sprinkler or fire alarm systems are to remain inactive at the end of the work day. Assure that the fire sprinkler or fire alarm system is operational at the end of each work day. Coordinate with the Owner.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 DEMOLITION

A. The Drawings generally indicate the extent of demolition, removals, relocations and cutting.

B. The Drawings are not to be construed as indicating all required work, nor indicating all conditions or details which might be encountered during progress of the work of this Contract.

C. Examine all areas where demolition is to occur to determine the actual conditions and requirements.

D. Provide temporary bracing, shoring, and support for the execution of the work and the protection of persons and property during demolition, cutting, remodeling and all related new construction under this Contract. Perform all work with appropriate supports, protection and methods to prevent collapse, settling or damage to property or persons. Provide adequate supports for the loads to be carried, properly distributed, to lower levels or to sound bearing, if necessary.

E. Provide all protective coverings and enclosures necessary to prevent damage to existing spaces and materials which are to remain. Protect openings in exterior walls and roofs to prevent damage from water and weather and to prevent excessive heat loss from the existing buildings. Maintain a watertight installation by scheduling the work and removals at the exterior according to weather conditions. Temporarily seal unfinished areas to the existing roof or to other exterior surfaces of the existing building.

F. Provide dustproof temporary enclosures (including above ceilings) to separate the areas under demolition and remodeling from the remainder of the building. Also provide temporary air filters and ductwork to keep construction dust contained within the construction area. Provide temporary hinged doors in temporary enclosures where necessary. Temporary and permanent doors to be completely sealed with tape or other suitable materials during demolition work and to remain sealed until the dust has settled.

G. Demolish and remove existing construction as shown or indicated or as required to accomplish the work.

H. Where new work is to be installed in or adjacent to existing construction or when existing work is to be replaced, remove or cut the existing construction as necessary to complete the work under the Contract.

I. Execute the work with care. Remove and replace existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced, or is rendered unsuitable for its intended use, as a result of the work at no additional cost to the Owner.

J. Clean demolition areas and remove debris, waste and rubbish from the building at the conclusion of each day's work. Transport debris and rubbish in a manner that prevents the spread of dust. Do not store or permit debris storage at the site. Do not burn or permit the burning of debris, rubbish or waste at the site. Keep adjacent areas unencumbered and clean. Keep all construction areas essentially broom clean.

K. Abandoned services may be left in place where they will be concealed inside floors or walls, providing they are disconnected from their sources and capped in place. No abandoned services, including piping, ductwork, tubing, etc., in ceilings or exposed.

L. Assure no "dead end" water, sewer, or vent piping is left in the completed work.

M. Based on a site inspection and the Contract Documents, the Contractor is responsible for the removal or rerouting of all anticipated mechanical work, exposed and concealed.

N. Where unanticipated mechanical work is exposed during the removal of partitions, walls, floors or ceilings, the removal or rerouting of this work to be accomplished by the Contractor under the direction of the Engineer.

O. Patch or otherwise restore disturbed existing construction and surfaces. Patching or restoration to be carried to natural breaks. Where existing construction is removed, cut or otherwise disturbed, patch all such disturbed and damaged surfaces.

P. Perform patching work by skilled mechanics experienced in the particular type of work involved. Conform to the standards of the Specifications where applicable, and where not specified, conform to the highest standards of the trade.

Q. Patch existing construction to match existing work, but always provide new materials and accomplish the work according to current standards. Examine existing surfaces before proceeding with the work. Report all conditions to the engineer, architect or owner, where existing materials, colors and finishes cannot be matched, but do not proceed until receiving instructions.

R. Repair existing construction that has been damaged as a result of the work to the extent required to match existing, undamaged construction.

S. All holes created by removal of existing systems, piping, ductwork, control wiring, tubing, etc., to be patched and fire caulked.

3.3 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.

2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current standards.

3. The Engineer reserves the right to reject material or workmanship not in accordance with the Contract Documents, before or after installation.

B. Piping

1. All piping to be run in the most direct and straight manner possible maintaining proper grading.

2. It is the intent of these plans and specifications that most piping be concealed. Where exposed, run as close to ceiling and/or wall as possible parallel with adjacent structural or architectural elements.

3. Do not install piping in any switchgear, transformer, elevator equipment, telephone, or electrical equipment room, unless it is a branch serving that room.

4. Do not install piping above switchboards, panelboards, control panels, motor control centers, etc.

5. Arrange work to facilitate maintenance, repair or replacement of equipment. Provide access for devices that require maintenance. For concealed devices, verify that access panels are properly located and labeled.

C. Equipment:

1. Install material and equipment in accordance with the Manufacturer's written instructions.

D. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to the General Contractor. Obtain special permission from the engineer before cutting structural members or finished material. Perform all patching in such a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.

2. Patch all holes left as a result of demolition of mechanical equipment and devices.

3. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for mechanical penetrations. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
4. Prevent the spread of dust, debris, and other material into adjacent areas.
5. Replace all ceiling tiles damaged during installation of work, with new tile.

E. Painting:

1. Refinish all mechanical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.

F. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of Division 0 and Division 1.
2. Maintain a complete set of Record Drawings showing all modifications to the Contract Documents. Drawings will be stamped “Record Drawings” and used only for that purpose.
3. As work progresses, record all changes or deviations from the contract drawings in a neat and legible manner as follows:
   a. Record exact location and elevation of underground mechanical systems including changes in direction, cleanouts etc., by reference to building lines, curbs, walks, and other permanent reference points.
   b. Record routing of concealed and exposed above ground mechanical systems where it varies from the Contract Documents.
4. The Engineer may recommend withholding payment if Record Drawings are not being maintained.
5. Submit Record Drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

3.4 PROTECTION

A. Protect openings and equipment from obstruction, breakage, misuse, damage or blemishes. Protect materials and equipment immediately upon receipt at the job site or immediately after they have been removed from their shipping containers. Unless noted otherwise, keep them clean and undamaged until final acceptance of the entire Project by the Owner. When a portion of the building is occupied by the Owner before substantial completion of the entire Project, make arrangements to transfer responsibility for protection and housekeeping for the occupied portion.

B. Protect pipe and equipment openings with temporary plugs or caps. Keep openings covered until permanent connections are complete.

C. Contractor is responsible for any damage to mechanical equipment, materials or work until final acceptance of the entire project by the Owner.

3.5 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean mechanical equipment and remove temporary identification.

B. In case of dispute, the Owner will remove the rubbish and charge the cost to the Contractor.

3.6 START-UP

A. Before start-up, lubricate, charge, and fill systems as specified and according to Manufacturer's instructions.

B. Test plumbing systems as specified in Sections governing their installation.

C. Perform testing, adjusting and balancing in accordance with that Section.

D. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final field observation and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

3.7 TESTING, ADJUSTING & BALANCING

A. Attend pre-testing conference as scheduled by Testing, Adjusting and Balancing Contractor.

B. Provide assistance to Test, Adjusting and Balancing Contractor by making adjustments to system and system components required for achieving design performance.

C. If acceptable performance of any test is not achieved, make the necessary corrections and the test to be repeated until acceptable performance is achieved.

3.8 FINAL FIELD OBSERVATION

A. A final field observation of the mechanical systems will be required before Contract Closeout. Request a final observation by the Engineer after all systems are fully completed and operational. The Engineer will schedule a field observation and generate a list of items to be corrected or completed before Contract Closeout.

B. If the Engineer is requested to make a final field observation by the Contractor, and the Engineer finds the work is not complete enough to perform that observation, the Contractor will compensate the Engineer for their time. The Contractor will then perform the necessary work to complete the project and again request a Final Field Observation.

3.9 TRAINING

A. Fully instruct the Owner's designated personnel in the operation of each mechanical system at the time it is put into service. Provide instruction using competent instructors and factory trained personnel.

B. Include documentation of instructions in the Operation and Maintenance Manuals.

C. Obtain a written statement from the Owner that his designated personnel have been instructed.

3.10 UTILITY REBATES

A. This Contractor to secure on behalf of the Owner all utility rebates associated with the design. This includes all submittals to the utility companies including substantiation where required and making all necessary arrangements on behalf of the Owner.

3.11 PROJECT CLOSEOUT

A. Operating and Maintenance Manuals: Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data to be appropriately marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer’s warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.
5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Local equipment suppliers/reps names, addresses, and telephone numbers.
10. Equipment manufacturers names, addresses, and telephone numbers.
11. Sub-contractors names, addresses, and telephone numbers.
12. Test reports.
13. Certifications.
14. Test and balance reports.
15. System validation reports.
16. Statement from Contractor that all incomplete items noted in Engineer’s Final Field Observation Report have been completed.
17. Statement from Owner confirming completion of Training.
18. Refer to individual Sections in Division 22 for additional requirements.

B. Record Drawings: Submit Record Drawings.

C. Extra Materials: Refer to individual Specification Sections for extra materials to be provided to the Owner.

D. System Startup: Refer to individual Specification Sections for system startup requirements.

3.12 JOB CLOSEOUT AND DOCUMENT TURNOVER

A. Construction Documents CD’s, Owner and Operation Manuals (O&M’s), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Record Drawings (As-Builts)

a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document. Include all approved PR’s, Change Order, CCD’s, field changes, etc. in closeout documents.

1) Scanning:

i) 200DPI Grayscale

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Owners and Operation Manuals

a. O & M's shall be turned over by the Contractor.

b. PDF Creation: Each book of specifications shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 200 DPI Grayscale

ii) Bookmarking: Bookmarking of O & M Manuals shall be extensive.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Division 22 Sections, including single phase and three phase electric motors.

B. Power factor correction.

C. Drives.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

1.3 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. NEMA MG 1 - Motors and Generators.

D. NEMA MG 30 & 31.

E. NFPA 70 - National Electrical Code.

F. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

G. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

1.5 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals.

B. Shop Drawings:

1. Include manufacturers product and nameplate data.
2. Include physical and performance data.
3. When used with variable frequency drive; certification that motor is compatible.
4. Include selection data for power factor correction capacitors.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 WARRANTY

A. Section 22 05 00 - Warranties.

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

A. Manufacturers:

1. Baldor.
2. General Electric.
3. Marathon.
4. Reliance.
5. Substitutions: Refer to Section 22 05 00.

B. General:

1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
2. Single Phase Motors:
   a. PSC for low starting torque, direct drive applications. Capacitor start for high starting torque applications.
   b. Single Phase Motors: Motor shall be an electronically commutated motor rated for continuous duty and furnished with internally mounted potentiometer speed controller suitable for speed control. Capacitor motors shall not be used.
3. Electrical Service (unless noted otherwise):
   a. Motors Smaller than 1/2 HP: single phase, 60 Hz.
   b. Motors 1/2 HP and Larger: three phase, 60 Hz.
   c. Refer to the Schedules on Drawings for voltage.
4. Motors to be started across-the-line, unless noted otherwise, or as noted below:
   a. 208-240 Volt: Part winding start for motors 25 HP and above.
   b. 480 Volt: Part winding start for motors 50 HP and above.
5. Open drip-proof (ODP) type except where specifically noted otherwise.
6. Totally enclosed fan cooled (TEFC), TEAO or TENV motors when exposed to the weather.
7. Design for continuous operation in 40 degrees C environment.
8. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
9. Explosion-Proof Motors: Class 1, Group D; and Class II, Group E, F and G.
10. Visible Nameplate: Indicating manufacturer's name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.
11. Wiring Terminations:
    a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

12. Motor Efficiencies

a. Efficiency: NEMA Premium Efficiency (1 hp and larger). Follow NEMA Standards Publication MG 1-2003, in Tables 12-12 and 12-13.

b. Exception: Motors on sump pumps, sewage ejectors, fire pumps, smoke exhaust fans and stairway pressurization.

13. Motors for use with Variable Frequency Drives

a. NEMA Standard MG1 definite purpose inverter duty rated motors to be used for all IGBT Pulse Width Modulated drive installations. Inverter duty motors to be designed and manufactured to meet NEMA Standard MG1 for definite purpose inverter duty motors. The inverter duty motors to be able to withstand voltages greater than 1600 volts peak and rise times of 0.1 microsecond.

b. Insulated of isolated bearings to be used for the inverter duty rated motors.

c. The inverter duty motor insulation class to be class F insulation and a class B temperature rise based on 40 degrees C.

d. The inverter duty motor name plate to indicate that the motor is an inverter duty motor.

e. Provide factory mounted shaft ground rings.

C. Single Phase Power – Electronically Commutated Motors:

1. Motor shall be an electronically commutated motor rated for continuous duty and furnished with internally mounted potentiometer speed controller suitable for speed control. Capacitor motors shall not be used.

D. Single Phase Power - Permanent Split Capacitor Motors:

1. Starting Torque: Exceeding one fourth of full load torque.

2. Starting Current: Up to six times full load current.

3. Multiple Speed: Through tapped windings.

4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Single Phase Power - Capacitor Start Motors:

1. Starting Torque: Three times full load torque.

2. Starting Current: Less than five times full load current.

3. Pull-up Torque: Up to 350 percent of full load torque.

4. Breakdown Torque: Approximately 250 percent of full load torque.

5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

F. Three Phase Power - Squirrel Cage Motors:

1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
5. Insulation System: NEMA Class F with Class B rise.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Weatherproof TEFC Motors: Epoxy seal windings using vacuum and pressure or coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.2 POWER FACTOR CORRECTION

A. Manufacturers:

1. Cornell-Dubelier.
2. General Electric.
3. Ronk Electrical Industries.
4. Sprague.
5. Westinghouse.
6. Zucker.

B. Provide power factor correction capacitors for motors 3 horsepower or larger in accordance with the following requirements. Capacitors to be selected so that they do not overcorrect the power factor beyond 99.99% throughout the range of operation of the motor. Reference to "full load" means the rated motor horsepower not including the service factor.

1. Motors with Constant Load: Correct to a minimum 95% power factor when operating at 65% of full load.
2. Two Speed Motors: Correct to a minimum of 95% power factor when operating at 65% of full load at low speed.

C. Motors that operate during emergency situations only, such as fire pumps, may be excluded from power factor correction. In addition, motors connected to variable speed drives to be excluded from the power factor correction requirements.

D. If equipment is furnished with a control panel, that panel to come with power factor correction capacitors factory installed and wired.

E. For equipment that does not have a control panel, the equipment supplier to be responsible for furnishing the capacitors and installing them at either the motor disconnect or motor control center.

F. Individual capacitors to be dry electrolytic type and enclosed in integrated dust tight enclosure.

2.3 MOTOR CONTROLLERS

A. In general, motor controllers will be furnished and installed under Division 26 unless the motor controller is an integral part of a piece of equipment, or noted otherwise.

B. Where control components are factory furnished, a control transformer with fused secondary to be provided to reduce voltage to 120 volts to operate control and safety devices.

2.4 BELT DRIVES

A. V-belt drives for equipment with motors smaller than 3 horsepower to be rated for 150% of rated horsepower of the driven equipment with matched pulleys and belts. V-belt drives for equipment with motors 3 horsepower and larger to be rated for 200%.

B. Variable pitch drives to be selected so that the fan speed at the specified operating conditions is approximately centered on the sheave adjustment range.

C. Exposed belt drives to have OSHA approved guards to completely enclose sheaves and belts. Guards to be constructed of expanded metal and reinforced with angle iron and securely fastened to floor or base. Provide openings at motor and driven equipment shafts for taking tachometer readings.

D. Except as specified otherwise, provide variable sheaves for motors 15 HP and smaller and fixed sheaves for motors 20 HP and larger.

E. Where motors are used with variable frequency drive systems, provide fixed sheaves. Select sheaves at an RPM which will provide 15 percent greater capacity that called out on drawings. Final capacity adjustments will be made with the variable frequency drive system.

F. Belt driven equipment to include an adjustable motor base for adjusting belt tension.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install motors, power factor correction capacitors, and drives in accordance with manufacturer’s instructions.

B. Power factor correction capacitors to motor starters by Division 26.

C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

D. Check line voltage and phase and ensure agreement with nameplate.

E. Check rotation of motor driven equipment and lubricate as recommended by manufacturer.

F. Align all drive systems and adjust belt tension. Remove pulley set screws, install thread locking substance on threads, and reinstall screws, torquing to manufacturer's specifications.

G. Check and adjust belt guards so that no parts are in contact with rotating equipment.

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

1.4 SUBMITTALS

A. Submit under provisions of Section 22 05 00.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 22 05 00.

B. Record actual locations of flexible pipe connectors.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 05 00.

B. Maintenance Data: Include adjustment instructions.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Provide year warranty under provisions of Section 22 05 00.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Adsco.
2. Flexonics.
3. Keflex.
4. Metra-Flex.
5. Minnesota Flexible Corp.
6. Substitutions: Refer to Section 22 05 00.

B. Copper Piping:

1. Manufacturers:
   a. Flexonics Series 201.
2. Inner Hose: Bronze
3. Exterior Sleeve: Braided bronze.
4. Pressure Rating: 700 psig WSP @ 70 degrees F for 1/2" pipe. 470 psig WSP @ 70 degrees F for 1" pipe. 475 psig WSP @ 70 degrees F for 2" pipe.
5. Joint: Flanged, threaded or welded as specified for pipe joints.
6. Size: Use pipe sized units.
7. Maximum offset: 3/4 inch on each side of installed center line.
8. Length: Flange size plus 10 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 FLEXIBLE PIPE CONNECTORS

A. Construct spool pieces to exact size of flexible connection for future insertion.

B. Provide flexible connectors on pipes connected to equipment supported by vibration isolation. [Provide on pumps, chillers, cooling towers, generators, air compressors.]

C. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

END OF SECTION

SECTION 22 05 19

GAGES AND THERMOMETERS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

C. Test plugs.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM E1 - Standard Specification for ASTM Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

D. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals.

B. Product Data: Provide manufacturers data and list which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00: Submittals.

B. Project Record Documents: Record actual locations of components and instrumentation.

C. Operation and Maintenance Data: Include instructions for calibrating instruments.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.7 MAINTENANCE PRODUCTS

A. Supply two bottles of red gage oil for static pressure gages.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturer: Trerice No.750 Series.

B. Other acceptable Manufacturers:

1. Ashcroft.
2. Crosby.
3. Marsh.

4. U.S. Gauge
5. Weiss
6. Substitutions: Refer to Section 22 05 00.

C. Gage: ASME B40.1, UL 404 with bourdon tube, liquid filled, rotary brass movement, brass socket, front recalibration adjustment, black scale on white background.

1. Case: Stainless Steel.
2. Fill: Glycerin.
3. Bourdon Tube: Brass.
4. Dial Size: 4-1/2 inch diameter.
5. Mid-Scale Accuracy: One percent.
6. Scale: Psig.

2.2 STEM TYPE THERMOMETERS

A. Manufacturer: Trerice Model BX93000.

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 22 05 00.

C. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.3 SOLAR POWERED STEM TYPE THERMOMETERS

A. Manufacturer: Trerice Model SX.

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 22 05 00.

C. Thermometer: ASTM E1, adjustable angle, LED Solar activated, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Test Plug:

1. Manufacturers:
   a. Pete's Plug.
   b. Sisco.
   c. Substitutions: Refer to Section 22 05 00.
2. 1/4 inch fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
   a. Neoprene core for temperatures up to 200 degrees F.
   b. Nordel core for temperatures up to 350 degrees F.
   c. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a. Two 3-1/2 inch diameter pressure gages.
      1) Scaled for each range required
   b. Two gage adapters with 1/8 inch probes.
   c. Two 1-1/2 inch dial thermometers.
      1) Scale range: 25 to 125 degrees F.
      2) Scale range: 50 to 500 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install one pressure gage per pump, with taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping.

C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

D. Coil and conceal excess capillary on remote element instruments.

E. Provide the following thermometer temperature ranges unless noted otherwise:

1. Domestic cold water; 0-100 degrees F.
2. Domestic hot water (140 degrees F maximum); 0-160 degrees F.
3. Domestic hot water (180 degrees F maximum); 30-240 degrees F.

F. Provide instruments with scale ranges selected according to service with largest appropriate scale.

G. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

I. Locate test plugs where indicated on drawings.

3.2 SCHEDULES

A. Pressure Gages.

1. Water service (near meter).
2. Elsewhere as indicated on drawings.

B. Solar Type Thermometers:

1. Domestic hot water supply and recirculation.
2. Inlet and outlet pipes to water heaters.
3. Water service (near meter).
4. Elsewhere as indicated on drawings.

C. Stem Type Thermometers:

1. Domestic hot and cold water supply and circulation.
2. Inlet and outlet pipes to water heaters.
3. Water service (near meter)
4. Elsewhere as indicated on drawings.

D. Test Plugs:

1. Where indicated on drawings.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valves for plumbing piping systems.

1. Globe.
2. Ball.
3. Check.
4. Ball (fuel).
5. Plug (fuel).

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

C. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide data on valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 22 05 00.

B. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC IX.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and Municipal plumbing code.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 22 05 00.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 GLOBE VALVES - (150 PSIG)

A. 2-1/2 inches and Larger:

1. Manufacturers: Stockham Model D-512, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts Regulator.
    f. Substitutions: Refer to Section 22 05 00.
2. Class 150, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.2 BALL VALVES - (150 PSIG)

A. Up to and including 2 inches:

1. Manufacturer: Apollo 77FLF-100/77FLF-200 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: Refer to Section 22 05 00.
2. Construction: Class 150, 600 psig wog, certified lead free, bronze, two piece body, brass ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle, solder or threaded ends, suitable for domestic water. Extended stems for use on insulated pipe.

B. Up to and including 2 inches:

1. Manufacturer: Apollo 82-100/82-200 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: Refer to Section 22 05 00.
2. Construction: Class 150, 600 psig wog, bronze, three piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle [with balancing stops], solder or threaded ends [with union]. Extended stems for use on insulated pipe.]

2.3 SWING CHECK VALVES - (150 PSIG)

A. Up To and including 2 1/2 inches:

1. Manufacturers: Watts UP1509, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Stockham.
    f. Victaulic (Alternate #8).
    g. Substitutions: Refer to Section 22 05 00.
2. Class 125, bronze body and cap, certified lead free, bronze swing disc with rubber seat, solder or threaded ends.

2.4 BALL VALVES - NATURAL GAS

A. Manufacturer:

1. Apollo.
2. Hammond.
3. Kitz.
4. Milwaukee.
5. Nibco.
6. Watts.
7. Substitutions: Refer to Section 22 05 00.

B. Construction 3/8" to 3": UL Listed for valves, Class 150, 600 wog for valves installed on systems over 5 psi. AGA Standard 3-88, ANSI Z21.15, CGA9.1 and CR91-002 for valves installed on systems 5 psi and less. Bronze body, chrome plated brass ball, Virgin PTFE (Teflon) seats and stem bearing, reinforced PTFE (15% glass Teflon) stem packing, lever handle, threaded ends, one quarter turn on/off and blow-out proof stem.

2.5 PLUG VALVES - NATURAL GAS

A. Manufacturer: DeZurick Series 400:

1. Substitutions: Refer to Section 22 05 00.
2. Construction 2-1/2 inches and Larger: UL Listed, 175 psig wog, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access where valves and fittings are not exposed.

C. Install valves with stems upright or horizontal, not inverted.

3.3 APPLICATION

A. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

B. Use globe valves for throttling, bypass, or manual flow control services.

C. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

D. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

E. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

F. Provide spring loaded check valves on discharge of water pumps.

G. Provide ball valves or plug valves in [natural] [propane] gas systems for shut-off service.

END OF SECTION

SECTION 22 05 29

HANGERS & SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 07 19 – Plumbing Piping Insulation.

C. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 REFERENCES

A. ASME B31.9 - Building Services Piping

1.4 SUBMITTALS

A. Product Data: Provide manufacturers catalog data including load capacity.

B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of plumbing piping.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Anvil.
2. B-Line Systems.
3. Michigan.
4. Tolco.
5. Substitutions: Under provisions of Section 22 05 00.

B. Plumbing Piping - DWV:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, and split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, and split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Stainless steel in areas of high humidity.

2.3 INSERTS

A. Manufacturers: Anvil Figure 282 (8 inches and smaller). Anvil Figure 282 with Figure 66 attachment (larger than 8 inches). Other acceptable manufacturers offering equivalent products.

1. B-Line Systems.
2. Michigan.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing: Waterproofing: 5 lb/sq ft sheet lead

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Pipes in building walls below grade: modular wall seal.

E. Stuffing and Fire stopping Insulation: Glass fiber type, non-combustible.

F. Sealant: Acrylic.

2.6 FIRESTOP SYSTEMS

A. Manufacturer:

1. 3M (Minnesota Mining and Manufacturing Co.).

2. Hilti.

3. Substitutions: Under provisions of Section 22 05 00.

B. Firestop systems that are produced and installed to resist the spread of fire according to requirements indicated, resist passage of smoke and other gasses, and maintain original fire-resistance rating of construction assembly.

C. Certificate of conformance for through-penetration requirements of ASTM E814 and UL1479.

D. Systems or devices listed in the UL Fire Resistance Directory under category XHCR (firestop devices) and XHEZ (firestop systems) may be used, providing that they conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system in symmetrical for wall applications.

E. Accessories include, but are not limited to; permanent forming/damming/backing materials, temporary forming materials, substrate primers, and collars and steel sleeves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Hangers for insulated pipe to be large enough to encompass the insulation and the metal protective shield, except that hangers may be applied directly to the pipe for domestic hot water and rainwater piping.

M. For glass pipe, provide pads or cushions on bearing surfaces of hangers to prevent scratching of pipe. Follow manufacturers instructions.

N. Support piping from building structure. Do not support piping from other mechanical or electrical components.

O. Do not support piping with wire or metal stripping hangers.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Provide for all floor mounted mechanical equipment.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal [floor] [shower] [mop sink] drains watertight to adjacent materials.

E. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

F. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch above finished floor level. Sleeves in mechanical room floor slabs to extend 6 inches above finished floor level. Calk sleeves.

D. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with stuffing insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIRE STOP SYSTEMS

A. Provide firestop systems for pipe through-penetrations of the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items: floor and ceilings, walls and partitions, smoke barriers, and construction enclosed compartmentalized areas.

B. Install through-penetration firestop systems to comply with manufacturer’s written installation instructions.

3.8 SCHEDULES

A. Piping:

PIPE SIZE Inches	MAX. HANGER SPACING (**) Feet	HANGER ROD DIAMETER Inches
Copper:		
1/2 to 1-1/4	6	3/8
1-1/2 to 4	10	3/8
5 and larger	10	1/2
Steel:		
1/2 to 3/4	10	3/8

1 to 4	12	3/8
5 to 8	12	1/2
10 to 12	12	5/8
PVC		
2 to 4	4	3/8
5 to 8	4	1/2
10 to 12	4	5/8
PP, PPFR, PVDF		
PEX-A		
1 and smaller	32”	3/8
1-1/4 to 4	4	3/8
5 to 8	4	1/2
10 to 12	4	5/8
C.I. No-Hub and at Joints	5*	3/4

(*) Support cast iron at every other joint unless over 4 feet, then support each joint not to exceed 10 feet.
(**) Per Minnesota Mechanical Code.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling Tacks.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

1.3 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Submit list of wording, symbols, letter size, and color coding proposed for plumbing identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two tags, 1-1/2 inches in size.

F. Samples: Submit two labels, 1.9 x 0.75 inches in size.

G. Manufacturer's Instructions: Indicate installation instructions, special procedures, and installation.

H. Samples: Submit two (2) signs each, 9” x 7” and 6” x 2” size.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

C. Valve Tag Chart.

1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/OSHA.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Seton.

2. Brady.

3. Substitutions: Refer to Section 22 05 00.

B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 22 05 00.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 22 05 00.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with smooth edges.

C. Tag Chart: Typewritten letter size list plastic laminated.

2.3 STENCILS

A. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Pipe Markers:

1. Manufacturers:

a. Brady.

b. Seton.

c. Substitutions: Refer to Section 22 05 00.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. No tape or adhesive necessary. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Markline.

b. Substitutions: Refer to Section 22 05 00.

2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS.

A. Manufacturer: Moore.

B. Other acceptable manufacturers offering equivalent products.

1. Substitutions: Refer to Section 22 05 00.

C. Description: Steel with ¾ inch diameter color coded head.

D. Color code as follows:

1. Plumbing (valves): Green.

2. Gases (valves): Blue.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags and signs using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify piping, concealed or exposed, with plastic pipe markers . Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Identification:

1. Piping: Use pipe service description and color schemes that are standard to the manufacturer.

2. Equipment: Use nomenclature as noted on the drawings.

3. Underground Utilities: Use nomenclature as noted on the drawings.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

C. Section 22 11 16 – Domestic Water and Natural Gas Piping: Placement of hangers.

1.3 REFERENCES

A. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

B. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. NAIMA National Insulation Standards.

E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.

B. Conform to ASTM Standards for “k” value, moisture vapor transmission, maximum moisture absorption, jacket, insulating cement, and adhesive.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER

A. Manufacturer: Johns Manville Micro-Lok HP (with integral vapor barrier).

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.
2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 22 05 00.

C. Insulation: ASTM C547; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket:

1. All service vapor retarder (ASJ).
2. Moisture vapor transmission: 0.02 perm-inches.

E. Vapor Barrier Lap Adhesive:

1. Compatible with insulation.

2.2 CELLULAR FOAM

A. Manufacturer: AP Armaflex by Armacell.

B. Other acceptable manufacturers offering equivalent products:

1. Halstead.
2. IMCOA/Nomaco.
3. Rubatex.
4. Substitutions: Refer to Section 22 05 00.

C. Insulation: ASTM C534; flexible, cellular elastomeric (or unicellular polyolefin), molded or sheet.

1. 'K' Value: 0.28 at 75 degrees F.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Maximum Moisture Absorption: 0.2 percent by weight.
5. Moisture Vapor Transmission: 0.05 perm-inches.
6. Connection: Waterproof vapor barrier adhesive.

7. Flame spread/smoke developed: Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.

D. Adhesive: Air dried, contact adhesive, compatible with insulation.

2.3 JACKETS

A. PVC Plastic:

1. Manufacturers:
   a. Zeston.
   b. Substitutions: Refer to Section 22 05 00.
2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: -40 degrees F.
   b. Maximum Service Temperature: 150 degrees F.
   c. Moisture Vapor Transmission: 0.002 perm-inches.
   d. Thickness: 10 mil minimum (use standard stock dimensions).
   e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic:
   a. Compatible with insulation.

B. Canvas Jacket: UL listed.

1. Fabric: 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive:
   a. Compatible with insulation.

C. Aluminum Jacket:

1. Thickness: .025 inch sheet.
2. Finish: Stucco embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

3. Insulation thickness on runouts, 2 inch and smaller, to individual terminal units may be reduced to 1/2 inch, within 12 feet of the unit.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and under the finish jacket.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 22 05 29.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

K. Exterior Applications: Increase scheduled insulation thickness by 1/2 inch. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES – BASED ON MINNESOTA ENERGY CODE

A. Plumbing Systems:

1. Domestic Hot Water Supply and Recirculation
    a. Glass Fiber Insulation:
        1) Pipe Size Range: 2 inch and less, 2-1/2 inch and larger.
        2) Thickness: 1 inch, 1-1/2 inch.
    b. Cellular Foam:
        1) Pipe Size Range: All sizes.
        2) Thickness: 1-1/2 inch.
2. Domestic Cold Water:
    a. Glass Fiber Insulation:
        1) Pipe Size Range: all sizes.
        2) Thickness: 1 inch.
    b. Cellular Foam:
        1) Pipe Size Range: all sizes.
        2) Thickness: 1 inch.
3. Roof Drain Bodies:
    a. Cellular Foam:
        1) Thickness: 1 inch.
4. Rainwater Piping Above Grade – Horizontal Only:
    a. Glass Fiber Insulation:
        1) Thickness: 1/2 inch. (where electrical heat taping occurs, use 1 inch thick).
5. Plumbing Vents Within 10 feet of the Exterior:
    a. Glass Fiber Insulation:
        1) Thickness: 1/2 inch.
6. Drains from Electric Water Coolers: (minimum of 10 feet)
    a. Glass Fiber Insulation:
        1) Thickness: 1/2 inch.
    b. Cellular Foam:
        1) Pipe Size Range: 2 inches and less.
        2) Thickness: 3/4 inch.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER AND NATURAL GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, connections, and testing for piping systems.

1. Domestic water.
2. Natural gas.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

D. Section 22 07 19 – Plumbing Piping Insulation.

E. Section 22 05 23 – General Duty Valves for Plumbing and Natural Gas Piping.

1.3 REFERENCES

A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

B. ASTM B88 - Seamless Copper Water Tube.

C. ASTM C1540 – Heavy Duty Shielded Couplings for Hubless Cast Iron.

D. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

E. UL 723 – Molded Plastic Surface Burning Characteristics.

F. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalog information.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 22 05 00.

B. Project Record Documents: Record actual routing of piping.

C. Piping system cleaning reports.

D. Piping system testing reports.

1.6 QUALITY ASSURANCE

A. Testing of all piping systems.

B. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC IX.

D. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and Municipal plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 WATER PIPING (EXTERIOR OF BUILDING)

A. Ductile Iron Pipe: AWWA C151.

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: Rubber gasket with ¾ inch diameter rods.

B. Copper Tubing: ASTM B88, type "K" soft copper, 2-1/2 inch and smaller.

1. Fittings: Cast copper alloy or wrought copper and bronze.
2. Joints: BCuP silver braze.

2.2 WATER PIPING (BELOW GRADE)

A. Copper Tubing: ASTM B88, type K" soft copper, 2-1/2" and smaller.

1. Fittings: Cast copper alloy or wrought copper and bronze.
2. Joints: BCuP silver braze.

B. Ductile Iron Pipe: AWWA C151.

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: Rubber gasket with ¾ inch diameter rods.

2.3 WATER PIPING (ABOVE GRADE)

A. Copper Tubing: ASTM B88, Type L, hard drawn, ½" to 4".

1. Fittings: Cast copper alloy or wrought copper and bronze.
2. Joints: 95/5 solder, except joints to be BCuP silver brazed at expansion loops.
3. Press fittings:
   a. Manufacturers:
      1) Viega ProPress.

2) Substitutions: None.

b. Material:

1) Tubing Standard: Copper tubing shall conform to ASTM B88.

2) Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME, B16.22, or ASME B16.26.

3) Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect®) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

4) Threaded Fittings: Pipe Threads shall conform to ASME B1.20.1.

5) Hanger Standard: Hangers and supports shall conform to MSS-SP-58.

2.4 NATURAL GAS PIPING (BURIED EXTERIOR OF BUILDING)

A. Steel Pipe: ASTM A53 Schedule 40 black.

1. Fittings: Forged steel welding type, with polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2. Joints: Welded.

B. Polyethylene Pipe: ASTM D2513, SDR 11.5.

1. Fittings: Socket type.

2. Joints: Fusion welded.

2.5 NATURAL GAS PIPING (ABOVE GRADE)

A. Steel Pipe: ASTM A53 Schedule 40 black. 2 inch and smaller exposed.

1. Fittings: Malleable iron.

2. Joints: Threaded.

B. Steel Pipe: ASTM A53 Schedule 40 black. 2 inch and smaller concealed, and 2 ½ inch and larger.

1. Fittings: Forged steel welding type.

2. Joints: Welded.

2.6 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 3 inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.

2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Pipe Size Over 1 inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, or Victaulic Clearflow dielectric waterway, water impervious isolation barrier.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify that excavations are to required grade, dry, and not over-excavated.

C. ProPress piping system:

1. Examine the copper tubing and fittings for defects, sand holes or cracks. There shall be no defects of the tubing or fittings. Any damaged tubing or fittings shall be rejected.

2. Ensure that sealing elements are properly in place and free from damage. For Sizes 2-1/2" to 4", ensure that the stainless steel grip ring is in place.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. ProPress piping system:

1. Copper tubing shall be cut with a wheeled tubing cutter or approved copper tubing cutting tool. The tubing shall be cut square to permit proper joining with the fittings.

2. Remove scale, slag, dirt and debris from inside and outside of tubing and fittings before assembly. The tubing end shall be wiped clean and dry. The burrs on the tubing shall be reamed with a deburring or reaming tool.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.

H. Provide access where fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than [8] ft of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Prime and paint all exterior natural gas pipe with two (2) coats of safety yellow epoxy paint.

N. Pipe relief valves full size to 12 inches above floor, run to floor drain if within 20 feet.

O. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

P. Install water piping to ASME B31.9.

Q. Sleeve pipes passing through partitions, walls and floors.

R. Pipe Hangers and Supports: Refer to Section 22 05 29.

S. ProPress piping system:

1. Pressure Rating: Install components having a pressure rating equal to or greater than the system operating pressure.
2. Install piping free of sags, bends and kinks.
3. Change in Direction: Install fittings for changes in direction and branch connections. Where approved, changes in direction may also be made by bending of Types K and L tube.
4. Solder Joints: Solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
5. Threaded Joints: Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
6. Flared Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose.
7. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
8. Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
9. Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve. Penetrations for fire resistant rated assemblies shall maintain the rating of the assembly.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Provide unions downstream of valves and at equipment or apparatus connections.

C. Provide brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Provide flow controls in all branches of water recirculating systems.

3.5 ERECTION TOLERANCES

A. Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.6 TESTING OF PLUMBING SYSTEMS

A. Provide final test with fixtures in place with 1 inch water column air pressure.

B. Test domestic water piping, tanks, etc. with hydraulic pressure of 125 psig for a period of 2 hours.

3.7 TESTING OF GAS PIPING

A. Test gas piping at 50 psig for 24 hours with no drop in pressure as dictated by local codes or Gas Co. if greater. Soap test all joints.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.9 SERVICE CONNECTIONS

A. Provide new water service complete with approved double check backflow preventer, water meter and pressure reducing valve.

1. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

B. Provide new gas service from house side of gas meter and regulator. Gas Utility Company to provide gas meter and regulator. Gas service distribution piping to have initial minimum pressure of 2 psig. Provide regulators on each pipe serving equipment and appliances, sized in accordance with equipment.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backflow preventers.

B. Water hammer arrestors.

C. Water pressure reducing valves.

D. Relief valves.

E. Strainers.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

C. Section 22 11 23 – Domestic Water Pumps.

D. Section 22 42 00 – Commercial Plumbing Fixtures.

1.3 REFERENCES

A. ASME A112.26.1 - Water Hammer Arrestors.

B. ASSE 1011 - Hose Connection Vacuum Breakers.

C. ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.

D. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

E. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

G. PDI WH-201 - Water Hammer Arrestors.

1.4 SUBMITTALS FOR REVIEW

A. Submit under the provisions of Section 22 05 00.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Warranties.

B. Project Record Documents: Record actual locations of all water piping specialties.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers:

1. Manufacturers:

   a. 900 Watts, Model 009QT.

   b. Substitutions: Refer to Section 22 05 00.

2. ANSI/ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.2 WATER HAMMER ARRESTORS

A. Manufacturer: Sioux Chief, Model 650 series.

B. Other acceptable manufacturers offering equivalent products.

1. PPP, Inc.; SC Series.

2. Watts Regulator.

3. Substitutions: Refer to Section 22 05 00.

C. ANSI A112.26.1; stainless steel, copper construction, piston type sized in accordance with PDI WH-201, precharged suitable for operation in temperature range 34 to 250 degrees F and maximum 150 psi working pressure.

2.3 WATER PRESSURE REDUCING VALVES

A. Up to 2 inches:

1. Manufacturers: Watts Series U5, or equivalent by:

   a. Amtrol.

   b. Honeywell-Braukmann

   c. Substitutions: Refer to Section 22 05 00.

2. Construction: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded double union ends, with integral stainless steel strainer.

B. Over 2 inches:

1. Manufacturers:

   a. Watts.

   b. Amtrol.

c. Honeywell-Brackman.

d. Substitutions: Refer to Section 22 05 00.

2. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.4 TEMPERATURE AND RELIEF VALVES

A. Temperature and Pressure Relief:

1. Manufacturers: Watts Type LF40L, or equivalent by:

a. Bell & Gossett.

b. Kunkle

c. Substitutions: Refer to Section 22 05 00.

2. AGA Z21.22 certified, lead free, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME SEC IV certified and labeled.

2.5 STRAINERS

A. Manufacturers:

1. Armstrong.

2. Hayward.

3. Metra-Flex.

4. Mueller.

5. Sarco.

6. Titan.

7. Watts.

8. Substitutions: Refer to Section 22 05 00.

B. Size 2 inch and Under: Threaded brass body for 200 psig wog, lead free, Y pattern with 20 mesh stainless steel perforated screen. Application: Bronze body with copper or brass pipe.

C. Size 2 inch to 4 inch: Class 125, flanged or grooved iron body, lead free, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5 inch and Larger: Class 125, flanged or grooved iron body, lead free, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs an elsewhere as noted on drawings..

C. Pipe relief from backflow preventer to nearest drain.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets water closets, dishwasher, hose stations and elsewhere as noted on drawings.

E. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

F. Install pressure reducing valves on dishwasher booster heater and elsewhere as noted on drawings.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, connections, and testing for system.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

D. Section 22 07 19 – Plumbing Piping Insulation.

1.3 REFERENCES

A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

B. ASTM A74 - Cast Iron Soil Pipe and Fittings.

C. ASTM C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

D. ASTM C1540 – Heavy Duty Shielded Couplings for Hubless Cast Iron.

E. ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

F. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

G. UL 723 – Molded Plastic Surface Burning Characteristics.

H. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalog information.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 22 05 00.

B. Project Record Documents: Record actual routing of piping.

C. Piping system cleaning reports.

D. Piping system testing reports.

1.6 QUALITY ASSURANCE

A. Testing of all piping systems.

B. Identify pipe with marking including size, ASTM material classification, ASTM specification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and Municipal plumbing code.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING (EXTERIOR OF BUILDING)

A. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.
2. Heavy duty joints: Neoprene gasket and stainless steel clamp and shield assemblies conforming to ASTM C1540.
    a. Manufacturers: Husky SD 4000, Clamp-All 125 or MG Coupling.

A. PVC Pipe: Schedule 40, ASTM D2665

1. Fittings: Schedule 40, PVC.
2. Joints: Solvent weld with solvent cement.
3. Install per ASTM D2321.

2.2 SANITARY WASTE AND VENT PIPING (BELOW GRADE)

A. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.
2. Heavy duty joints: Neoprene gasket and stainless steel clamp and shield assemblies conforming to ASTM C1540.
    a. Manufacturers: Husky SD 4000, Clamp-All 125 or MG Coupling.

B. PVC Pipe: Schedule 40, ASTM D2665

1. Fittings: Schedule 40, PVC.
2. Joints: Solvent weld with solvent cement.
3. Install per ASTM D2321.

2.3 SANITARY WASTE AND VENT PIPING (ABOVE GRADE)

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Heavy duty joints: Neoprene gasket and stainless steel clamp and shield assemblies conforming to ASTM C1540.
    a. Manufacturers: Husky SD 4000, Clamp-All 125 or MG Coupling.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.

H. Provide access where fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than 8 feet of cover wherever possible. All pipe exterior of the building with less than 8 feet of cover shall be cast iron. Install two (2) layers of 1" thick, 4'x8' closed cell foam insulation for the length of the pipe. Stagger joints. Insulation shall extend 4' out from centerline of pipe.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Sleeve pipes passing through partitions, walls and floors.

N. Pipe Hangers and Supports: Refer to Section 22 05 29.

O. All PVC pipes to have expansion joints every 35 feet as approved by applicable codes.

P. Install underground PVC per ASTM D2321.

3.4 ERECTION TOLERANCES

A. Establish invert elevations, slopes for drainage to 1/4 inch per foot (smaller than 3 inch pipe), and 1/8 inch per foot (3 inches and larger) minimum. Maintain gradients.

3.5 TESTING OF PLUMBING SYSTEMS

A. Test sanitary and vent piping with air pressure of 5 psig for a period of 15 minutes.

B. Provide final test with fixtures in place with 1 inch water column air pressure.

3.6 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor drains.

B. Cleanouts.

C. Backwater valves.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 13 16 – Sanitary Waste and Vent Piping.

C. Section 22 13 29 – Sanitary Sewage Pumps.

D. Section 22 42 00 – Commercial Plumbing Fixtures.

1.3 REFERENCES

A. ASME A112.14.1 – Backwater Valves.

B. ASME A112.21.1 - Floor Drains.

1.4 SUBMITTALS FOR REVIEW

A. Submit under the provisions of Section 22 05 00.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Warranties.

B. Project Record Documents: Record actual locations of all sanitary specialties.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

A. Manufacturers: Josam Model (Refer to Schedule on Drawings), or equivalent by:

1. J.R. Smith.

2. Mifab.

3. Wade.
4. Watts Drainage Products.
5. Zurn.
6. Substitutions: Refer to Section 22 05 00.

B. ANSI A112.21.1; lacquered cast-iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.2 CLEANOUTS

A. Manufacturer; Josam Series 56000 for floors and Series 58600 for walls, or equivalent by:

a. J.R. Smith.
b. Mifab.
c. Wade.
d. Watts Drainage Products.
e. Zurn.
f. Substitutions: None.

B. Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange and nikaloy top, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

C. Interior Unfinished Floor Areas:

1. Lacquered cast iron body with anchor flange and bronze top, reversible clamping collar, threaded top assembly, and round gasketed scored cover.

D. Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

E. Interior Unfinished Accessible Areas:

1. Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.3 BACK WATER VALVES W/ SHEAR GATE VALVE

A. Manufacturer: Josam Model 67360.

B. Other acceptable manufacturers offering equivalent products.

1. J. R. Smith.
2. Mifab.
3. Wade.
4. Zurn.

C. Construction: ANSI A112.14.1; coated cast iron combination backwater valve, straight-through type, bronze swing-check assembly, bronze manually operated shear-gate with non-rising stem and hub and spigot connections. Removable handle.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

END OF SECTION

SECTION 22 14 29

SUMP PUMP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sump pumps.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work results for Plumbing.

B. Section 22 00 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

1.3 REFERENCES

A. ASHRAE 90A - Energy Conservation in New Building Design.

B. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals.

B. Product Data:

1. Indicate pump type, capacity, power requirements.
2. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
3. Provide electrical characteristics and connection requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Project Closeout.

B. Project Record Documents: Record actual locations of components.

C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).
3. National Electrical Manufacturers' Association (NEMA).
4. Underwriters Laboratories (UL).

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY

A. Section 22 05 00 - Warranties.

B. Provide five year manufacturer warranty for submersible sump pumps.

PART 2 PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Manufacturer:

1. Bell & Gossett.
2. Flygt.
3. Hydromatic.
4. Metropolitan.
5. Peerless.
6. Weil.
7. Zoeller.
8. Substitutions: Refer to Section 22 05 00.

B. Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Strainer: Stainless steel.

E. Impeller: Cast iron shaft.

F. Bearings: Ball bearings.

G. Sump: Fiberglass basin with steel cover plate; 30 inches diameter, 84 inches deep.

H. Accessories: Oil resistant 15-foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

I. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

J. Controls: UL listed, single phase panel with motor starter relay, high water level sensor, operating water level sensor, seal fail fault and high temperature controls, NEMA 4X enclosure, dry contacts. Provide manual/off/auto switch, pump reset switch, test button, and silence button. Provide wiring suitable for sump basin depth.

K. Performance: Refer to schedule on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate with plumbing piping and related electrical work to achieve operating system.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mop sinks.

B. Hose bibbs.

C. Hydrants.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

C. Section 22 13 16 – Sanitary Waste and Vent Piping.

1.3 REFERENCES

A. ANSI A117.1 – Accessible and Usable Buildings and Facilities.

B. ANSI Z124.1 - Gel-Coated Glass-Fiber Reinforced Polyester Resin Bathtub Units.

C. ANSI Z124.2 - Gel-Coated Glass-Fiber Reinforced Polyester Resin Shower Receptor and Shower Stall Units.

D. ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.

E. ARI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.

F. ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

G. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

H. ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

I. ASME A112.19.2 - Vitreous China Plumbing Fixtures.

J. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

K. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

L. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

M. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals: Procedures for submittals.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Project Closeout.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Fixtures shall be free from flaws and blemishes, with finished surfaces clear, smooth and bright. Surfaces coming into contact with walls, floors or surfaces of other fixtures shall be ground true.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 WARRANTY

A. Section 22 05 00 - Warranties.

1.10 EXTRA MATERIALS

A. Section 22 05 00 - Project Closeout.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mop sinks; Fiat, Mustee, Stern-Williams, Swan, Zurn..

1. Faucets; Chicago Faucet, Zurn.

B. Hose bibbs: Chicago Faucet, T&S, Woodford, Zurn.

C. Hydrants; Josam, Jonespec, J.R. Smith, Wade, Woodford, Zurn.

D. Substitutions; Refer to Section 22 05 00.

2.2 MOP SINKS

A. P-1 Mop Sink: Fiat Model MSB-2424, "Molded Stone" mop basin 24 inches x 24 inches x 10 inches high with rim guard, 3 inch drain and stainless steel or brass strainer, and caulked deep seal "P" trap.

1. Trim: Chicago Faucet No. 897-CP chrome plated service sink fitting with 3/4 inch hose connection, vacuum breaker, wall brace and pail hook. Install 36 inches above floor. Also provide Fiat No. 832-AA hose and stainless steel hose bracket.

2.3 HOSE BIBBS

A. P-2 Interior Hose Bibb: Chicago Faucet No. 998-RCF rough chrome finish inside sill fitting, for exposed piping, 3/4 inch male hose threaded outlet. Furnished with 893 vacuum breaker and 293-6 loose key handle.

2.4 HYDRANTS

A. P-3 Wall Hydrant: Woodford 3/4 inch Model B67 Series automatic draining freezeless wall faucet with vacuum breaker and locking door. All internal parts shall be renewable from the outside face of the hydrant. Hydrant vacuum breaker shall be field testable per ASSE 1052.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in Plumbing Fixture Schedule on Drawings.

B. Provide brackets, braces or reinforcing angles as required in all partitions not sufficient in themselves to support plumbing fixtures or other wall-hung equipment.

3.3 INSTALLATION

A. Connect fixture waste to waste line with iron ferrule and threaded pipe, other than water closets and trap standard fixtures.

B. Install each fixture with chrome plated, 17 gauge tubing trap with cleanout, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.

D. Install components level, plumb and secure.

E. Install and secure fixtures in place with wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

G. Mount lever control for handicapped water closets on wide side of toilet stall.

H. Insulate waste and supplies for all handicapped fixtures.

I. Connect floor mounted water closets with cast iron floor flange with ring putty or gaskets.

J. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

K. Provide carriers with full baffle plates for back-to-back blowout water closets.

L. Provide stop and waste valve on branch piping to all wall hydrants.

M. Provide locking style stop valves in branch lines serving safety equipment.

3.4 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

A. Clean plumbing fixtures and equipment.

3.6 PROTECTION OF FINISHED WORK

A. Do not permit use of fixtures during construction.

3.7 SCHEDULES

A. Fixture Heights: Refer to Architectural Drawings.

B. Fixture Rough-In: Refer to Plumbing Fixture Schedule on Drawings.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDES

A. Furnishing labor, materials, equipment and services required for the complete installation of new heating, ventilating and air conditioning systems as shown on the Drawings and specified in Division 23.

B. All work shall be complete and shall be left in operating condition.

C. Include all parts and labor, which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents.

D. Some equipment and materials provided under Division 22, 23, 25 or Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 22, 23, 25 and Division 26 Contract Documents to determine where these composite crews are required.

E. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project. Pay all fees and costs charged by utility companies for utility services.

F. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.

G. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.

H. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.

I. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

J. Furnish labor, equipment, and materials required for cutting, demolition, removal, patching, and restoration work necessary to accomplish and complete all demolition, including any relocation or reuse of existing materials, equipment, systems, as well as the disposition of salvaged materials or debris.

1.2 RELATED SECTIONS

A. General Provisions are specifically applicable to all Division 23 Sections.

B. Divisions 0 and 1 apply to all work of Division 23 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 23 05 00 takes precedence. Section 23 05 00 specifies conditions, procedures, equipment and material particular to the mechanical work and applies to all mechanical work of the Contract Documents.

C. Division 0 and 1 and Section 23 05 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 23 work. Copy these documents to all Sub-contractors receiving other Sections of Division 23.

D. Where a Specification Section refers to other Sections under the Article on “Related Sections”, this is done for Contractor’s convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division’s Specifications as well as for information contained in all other Divisions.

1.3 WORK SEQUENCE

A. Coordinate all work of this Section with all subcontractors so the work will progress without interruption and without delays.

B. Coordinate and schedule the work with the Owner and Construction Manager where possible disturbance may occur or where relocations or other potential disruptions of the Owner's functions and services are required. Perform all work affecting the Owner's functions and services at times acceptable to the Owner, even if this requires the Contractor to do the work in stages as directed by the Owner and Construction Manager.

1.4 ALTERNATES

A. Alternates: Refer to Bid Form and Instruction to Bidders.

1.5 REGULATORY REQUIREMENTS

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

Americans with Disabilities Act
Municipal Water and Sewer Regulations
National Electric Code
NFPA 90A Air Conditioning and Ventilating Systems
NFPA 101 Life Safety Code
Occupational Safety and Health Administration Regulations
State and Local Building Codes
State and Local Electrical Codes
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State and Local Plumbing Codes
State Industrial Commission Regulations
State Elevator Code
State Energy Code
Uniform Federal Accessibility Standards
AIA Guidelines
NFPA 99 Health Care Facilities

1.6 REFERENCES

A. Use the Standard where referenced in the specifications by the following abbreviations:

AABC - Associated Air Balance Council
ADC - Air Diffusion Council

AGA - American Gas Association
AIA - American Institute of Architects
AMCA - Air Moving and Conditioning Association, Inc.
ANSI - American National Standards Institute
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society of Testing and Materials
AWWA - American Water Works Association
EPA - Environmental Protection Agency
FM - Factory Mutual
IEEE - Institute of Electrical and Electronic Engineers
IES - Illuminating Engineering Society of North America
ICEA - International Cable Engineers Association
IRI - Industrial Risk Insurance
NEBB - National Environmental Balancing Bureau
NBFU - National Bureau of Fire Underwriters
NBS - National Bureau of Standards
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NSC - National Safety Council
OSHA - Occupational Safety and Health Administration
PDI - Plumbing and Drainage Institute
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
UL - Underwriter's Laboratories

1.7 DEFINITIONS

A. Contract Documents: References to Contract Documents refers to a complete set of Drawings and Specifications for the entire Project. Drawings and Specifications are intended to supplement one another. Provide items shown on the Drawings but not mentioned in the Specifications and items mentioned but not shown the same as if they were both mentioned and shown. Bid the most expensive interpretation of a conflict between Drawings and Specifications so the conflict can be resolved with a deduct rather than an add to the contract amount.

B. Dimensions: Arrangement of equipment, accessories, piping and ductwork on the Drawings is generally diagrammatic unless the Drawings include dimensions. Do not scale the Drawings. Field verify all dimensions at the site to locate new and existing work.

C. Furnish: To obtain, coordinate, submit the necessary drawings, deliver to the job site in new condition ready for installation, unload and unpack, and guarantee.

D. Install: To receive at the job site, store, assemble, erect, set in place, anchor, apply, finish, protect, clean, test, start-up, and make ready for Owner’s use.

E. Provide: To furnish and install.

F. Responsibility: Where verbs such as “furnish”, “provide”, “install”, or “use” appear in the Contract Documents, they mean, “The Mechanical Contractor shall furnish, provide, install, or use…..” unless the requirement is introduced by a phrase, sentence or heading specifically identifying the requirement as the responsibility of someone else.

1.8 SUBMITTALS

A. Substitutions

1. Submit written requests to use products not listed in the Specifications to the Engineer no later than ten (10) calendar days prior to the bid opening. Requests must be submitted by a bidding Contractor. Submit detailed information for proposed material or equipment.
2. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.
3. Contractor is responsible for dimensional differences, weights, electrical requirements and any other resulting changes, when using equipment other than that scheduled on the Drawings. Contractor is responsible for any additional costs incurred as a result of substitutions, including other Contractors and Architect/Engineer fees.
4. Material and equipment not listed in the Specifications or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

B. List of Materials, Equipment and Sub-Contractors

1. Submit a complete list of all materials, equipment, and sub-contractors, proposed to be used on this project, to the Engineer within seven (7) calendar days of the award of contract or written notice to proceed.
2. Acceptance of items on the list are considered final, unless additional information or submissions are required by the Engineer. Unacceptable items will be rejected and resubmitted.

C. Pay Request Cost Breakdown

1. Provide Schedule of Values for the utilization of submitting a "Pay Request". Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.
2. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or as requested by the Engineer.
    a. Basic Materials and Methods
    b. Building Service Piping
    c. Process Piping
    d. Heat Generation Equipment
    e. Heating, Ventilating and Air Conditioning Equipment
    f. Air Distribution
    g. HVAC Instrumentation and Controls
    h. Testing, Adjusting and Balancing

D. Submittals for Review

1. Submit in accordance with Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.
2. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacturer, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned <u>without</u> review.

3. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.
4. Submit PDF of each set of shop drawings based off of specification sections to the Architect & Engineer. Red lined PDF shall be returned to the Architect, Construction Manager or General Contractor - (two copies to be incorporated into the O&M Manuals.
5. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.
6. Submittals will be reviewed with the following actions:
   a. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.
   b. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.
   c. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.
   d. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.
7. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.
8. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.
9. Submit shop drawings for the following equipment and systems:

Section	**Description**
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 16	Expansion Fittings and Loops for HVAC Piping
23 05 19	Meters and Gages for HVAC Piping
23 05 23	General Duty Valves for HVAC Piping
23 05 29	Hanger and Supports for HVAC Piping, Ductwork and Equipment
23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 53	Identification for HVAC Piping, Ductwork and Equipment
23 05 93	Testing, Adjusting and Balancing for HVAC
23 07 13	Duct Insulation
23 07 19	HVAC Piping Insulation
23 20 13	Hydronic Piping
23 20 19	Hydronic Specialties
23 21 23	Hydronic Pumps

23 23 13	Refrigerant Piping, Valves and Specialties
23 25 31	Water Treatment for Heating Systems
23 31 13	Metal and Non-Metal Ductwork, Casings and Plenums
23 33 13	Ductwork Accessories
23 37 13	Air Outlets and Inlets
23 52 38	Condensing Boilers
23 74 13	Packaged Outdoor Roof Top Units
23 74 33	Packaged Outdoor Roof Top Heating and Cooling Make-Up Air Units
23 82 36	Finned-Tube Radiation Heaters
23 82 39	Unit Heaters

1.9 CAD DRAWING FILES

A. The mechanical CAD drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.10 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.

C. Accomplish all work of cutting, removal, demolition, relocation, patching, and restoration by using only mechanics skilled in the trade required. Provide for the safety of the existing building and personnel, as well as for new construction as a result of work, procedures, operations or activities under this Contract.

D. Where the work of removals, demolition, cutting and similar work involves structural considerations, consult with Engineer. Exercise extreme care to avoid damage and preserve the safety of the structure and of all personnel. Particular care must be taken where the demolition or removals occur adjacent to occupied areas.

E. Utilize competent and qualified technical assistance to develop safe methods and techniques to accomplish the work, including temporary shoring and supports, methods of removal and other considerations. Design and place all permanent or temporary supports to carry all loads down to sound bearing.

1.11 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.
2. Mechanical equipment and systems shown on the drawings as existing, have been based on existing plans, and may not be installed as originally shown. It is the contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of Division 26 and other trades for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that can not be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.
2. Drawings may not show every rise and offset required for the work. Install piping and ductwork to accommodate the building structure and the work of other trades, with all required offsets and without extra cost to the Owner.
3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.
4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.
5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.
6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and Specifications are complementary and what is called for in either is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the Drawings and Specifications.

1.12 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specified in other Sections.

1.13 ELECTRICAL

A. Magnetic starters, disconnects, and power wiring provided by the Electrical Contractor, unless otherwise specified.

B. Control and interlock wiring provided by the Mechanical Contractor, unless otherwise specified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S, VENDORS, SUPPLIERS OR AGENTS

A. Provide only products and services from manufacturers, vendors, suppliers or agencies with local representation and listed in these specifications that can provide complete coverage, parts and labor, for replacement and service of their products and listed in these specifications. Provide only equipment that will fit in the space available and be completely serviceable. Bring any conflicts to the Engineer's attention prior to ordering the equipment. Wholesale suppliers are not considered manufacturer representative unless they can provide the services listed in these specifications.

2.2 DEMOLITION

A. Remove salvageable materials and other items designated for reuse or relocation by the applicable trades and relocated to the new location.

B. If the new location is not ready to receive the relocated materials, store and protect from damage until they can be incorporated into the new work.

C. If the Owner is unable to forego the use of any existing items at the normal time for relocation, make all preparations for that work and then delay relocation until a time approved by the Owner or until other facilities are available to the Owner.

D. Carefully remove, clean, salvage and preserve all materials indicated to be reused, or which will be needed for reuse to match existing work.

E. Exercise extreme care in removals to prevent damage which would make materials unsuitable for reuse.

F. Replace all damaged materials, which were shown, tagged or needed for reuse, with equivalent.

2.3 SALVAGEABLE MATERIALS TO BE STORED BY OWNER

A. The Owner will mark or tag existing materials, equipment or other items he wishes to retain.

B. Carefully remove salvageable materials and items designated or marked to remain the property of the Owner. Protected from damage and store adjacent to the removal area as directed.

C. Consult the Owner about any salvage he may wish to retain and about the salvageability of all items. Carefully remove and salvage any materials the Owner wishes to retain.

D. Cleaning or restoration of the Owner's salvaged materials is not a part of this contract.

E. Relocate salvage material from the area and the site to the Owner's storage.

2.4 UNSALVAGEABLE MATERIALS

A. Remove all unsalvageable materials in a manner that will avoid damage to materials or equipment which will remain. Completely remove from the site as approved by and scheduled with the Owner.

B. Legally dispose of all unsalvageable materials away from the site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Continuity of Service:

1. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.

2. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

3. No fire sprinkler or fire alarm systems are to remain inactive at the end of the work day. Assure that the fire sprinkler or fire alarm system is operational at the end of each work day. Coordinate with the Owner.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 DEMOLITION

A. The Drawings generally indicate the extent of demolition, removals, relocations and cutting.

B. The Drawings are not to be construed as indicating all required work, nor indicating all conditions or details which might be encountered during progress of the work of this Contract.

C. Examine all areas where demolition is to occur to determine the actual conditions and requirements.

D. Provide temporary bracing, shoring, and support for the execution of the work and the protection of persons and property during demolition, cutting, remodeling and all related new construction under this Contract. Perform all work with appropriate supports, protection and methods to prevent collapse, settling or damage to property or persons. Provide adequate supports for the loads to be carried, properly distributed, to lower levels or to sound bearing, if necessary.

E. Provide all protective coverings and enclosures necessary to prevent damage to existing spaces and materials which are to remain. Protect openings in exterior walls and roofs to prevent damage from water and weather and to prevent excessive heat loss from the existing buildings. Maintain a watertight installation by scheduling the work and removals at the exterior according to weather conditions. Temporarily seal unfinished areas to the existing roof or to other exterior surfaces of the existing building.

F. Provide dustproof temporary enclosures (including above ceilings) to separate the areas under demolition and remodeling from the remainder of the building. Also provide temporary air filters and ductwork to keep construction dust contained within the construction area. Provide temporary hinged doors in temporary enclosures where necessary. Temporary and permanent doors shall be completely sealed with tape or other suitable materials during demolition work and shall remain sealed until the dust has settled.

G. Demolish and remove existing construction as shown or indicated or as required to accomplish the work.

H. Where new work is to be installed in or adjacent to existing construction or when existing work is to be replaced, remove or cut the existing construction as necessary to complete the work under the Contract.

I. Execute the work with care. Remove and replace existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced, or is rendered unsuitable for its intended use, as a result of the work at no additional cost to the Owner.

J. Clean demolition areas and remove debris, waste and rubbish from the building at the conclusion of each day's work. Transport debris and rubbish in a manner that prevents the spread of dust. Do not store or permit debris storage at the site. Do not burn or permit the burning of debris, rubbish or waste at the site. Keep adjacent areas unencumbered and clean. Keep all construction areas essentially broom clean.

K. [Abandoned services may be left in place where they will be concealed inside floors or walls, providing they are disconnected from their sources and capped in place.] [No abandoned services, including piping, ductwork, tubing, etc., in ceilings or exposed.]

L. Based on a site inspection and the Contract Documents, the Contractor is responsible for the removal or rerouting of all anticipated mechanical work, exposed and concealed.

M. Where unanticipated mechanical work is exposed during the removal of partitions, walls, floors or ceilings, the removal or rerouting of this work shall be accomplished by the Contractor under the direction of the Engineer.

N. Patch or otherwise restore disturbed existing construction and surfaces. Patching or restoration shall be carried to natural breaks. Where existing construction is removed, cut or otherwise disturbed, patch all such disturbed and damaged surfaces.

O. Perform patching work by skilled mechanics experienced in the particular type of work involved. Conform to the standards of the Specifications where applicable, and where not specified, conform to the highest standards of the trade.

P. Patch existing construction to match existing work, but always provide new materials and accomplish the work according to current standards. Examine existing surfaces before proceeding with the work. Report all conditions to the engineer, architect or owner, where existing materials, colors and finishes cannot be matched, but do not proceed until receiving instructions.

Q. Repair existing construction that has been damaged as a result of the work to the extent required to match existing, undamaged construction.

R. All holes created by removal of existing systems, piping, ductwork, control wiring, tubing, etc., shall be patched and fire caulked.

3.3 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.
2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current standards.
3. The Engineer reserves the right to reject material or workmanship not in accordance with the Contract Documents, before or after installation.

B. Piping and Ductwork

1. All piping and ductwork shall be run in the most direct and straight manner possible maintaining proper grading.
2. It is the intent of these plans and specifications that most piping and ductwork be concealed. Where exposed, run as close to ceiling and/or wall as possible parallel with adjacent structural or architectural elements.
3. Do not install piping or ductwork in any switchgear, transformer, elevator equipment, telephone, or electrical equipment room, unless it is a branch serving that room.
4. Do not install piping or ductwork above switchboards, panelboards, control panels, motor control centers, etc.
5. Arrange work to facilitate maintenance, repair or replacement of equipment. Provide access for devices that require maintenance. For concealed devices, verify that access panels are properly located and labeled.

C. Equipment:

1. Install material and equipment in accordance with the Manufacturer's written instructions.

D. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to the General Contractor. Obtain special permission from the engineer before cutting structural members or finished material. Perform all patching in such a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
2. Patch all holes left as a result of demolition of mechanical equipment and devices.
3. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for mechanical penetrations. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
4. Prevent the spread of dust, debris, and other material into adjacent areas.
5. Replace all ceiling tiles damaged during installation of work, with new tile.

E. Painting:

1. Refinish all mechanical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.

F. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of Division 0 and Division 1.

2. Maintain a complete set of Record Drawings showing all modifications to the Contract Documents. Drawings will be stamped “Record Drawings” and used only for that purpose.
3. As work progresses, record all changes or deviations from the contract drawings in a neat and legible manner as follows:
    a. Record exact location and elevation of underground mechanical systems including changes in direction, cleanouts etc., by reference to building lines, curbs, walks, and other permanent reference points.
    b. Record routing of concealed and exposed above ground mechanical systems where it varies from the Contract Documents.
4. The Engineer may recommend withholding payment if Record Drawings are not being maintained.
5. Submit Record Drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

3.4 TEMPORARY UTILITIES

A. Do not use heating, ventilating and air conditioning systems provided in this scope of work for temporary heating, ventilating and air conditioning during construction.

3.5 PROTECTION

A. Protect openings and equipment from obstruction, breakage, misuse, damage or blemishes. Protect materials and equipment immediately upon receipt at the job site or immediately after they have been removed from their shipping containers. Unless noted otherwise, keep them clean and undamaged until final acceptance of the entire Project by the Owner. When a portion of the building is occupied by the Owner before substantial completion of the entire Project, make arrangements to transfer responsibility for protection and housekeeping for the occupied portion.

B. Protect pipe, duct and equipment openings with temporary plugs or caps. Keep openings covered until permanent connections are complete.

C. Contractor is responsible for any damage to mechanical equipment, materials or work until final acceptance of the entire project by the Owner.

3.6 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean mechanical equipment and remove temporary identification.

B. In case of dispute, the Owner will remove the rubbish and charge the cost to the Contractor.

3.7 START-UP

A. Before start-up, lubricate, charge, and fill systems as specified and according to Manufacturer’s instructions.

B. Test hydronic systems and air systems as specified in Sections governing their installation.

C. Perform testing, adjusting and balancing in accordance with that Section.

D. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final field observation and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

3.8 TESTING, ADJUSTING & BALANCING

A. Attend pre-testing conference as scheduled by Testing, Adjusting and Balancing Contractor.

B. Provide assistance to Test, Adjusting and Balancing Contractor by making adjustments to system and system components required for achieving design performance.

C. If acceptable performance of any test is not achieved, make the necessary corrections and the test shall be repeated until acceptable performance is achieved.

3.9 FINAL FIELD OBSERVATION

A. A final field observation of the mechanical systems will be required before Contract Closeout. Request a final observation by the Engineer after all systems are fully completed and operational. The Engineer will schedule a field observation and generate a list of items to be corrected or completed before Contract Closeout.

B. If the Engineer is requested to make a final field observation by the Contractor, and the Engineer finds the work is not complete enough to perform that observation, the Contractor will compensate the Engineer for their time. The Contractor will then perform the necessary work to complete the project and again request a Final Field Observation.

3.10 TRAINING

A. Fully instruct the Owner's designated personnel in the operation of each mechanical system at the time it is put into service. Provide instruction using competent instructors and factory trained personnel.

B. Include documentation of instructions in the Operation and Maintenance Manuals.

C. Obtain a written statement from the Owner that his designated personnel have been instructed.

3.11 UTILITY REBATES

A. This Contractor shall secure on behalf of the Owner all utility rebates associated with the design. This shall include all submittals to the utility companies including substantiation where required and making all necessary arrangements on behalf of the Owner.

3.12 PROJECT CLOSEOUT

A. Operating and Maintenance Manuals: Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data shall be appropriate marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer’s warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.

5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Local equipment suppliers/reps names, addresses, and telephone numbers.
10. Equipment manufacturers names, addresses, and telephone numbers.
11. Sub-contractors names, addresses, and telephone numbers.
12. Test reports.
13. Certifications.
14. Test and balance reports.
15. System validation reports.
16. Statement from Contractor that all incomplete items noted in Engineer's Final Field Observation Report have been completed.
17. Statement from Owner confirming completion of Training.
18. Refer to individual Sections in Division 23 for additional requirements.

B. Record Drawings: Submit Record Drawings.

C. Extra Materials: Refer to individual Specification Sections for extra materials to be provided to the Owner.

D. System Startup: Refer to individual Specification Sections for system startup requirements.

3.13 JOB CLOSEOUT AND DOCUMENT TURNOVER

A. Construction Documents CD's, Owner and Operation Manuals (O&M's), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Record Drawings (As-Builts)

a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document. Include all approved PR's, Change Order, CCD's, field changes, etc. in closeout documents.

1) Scanning:

i) 200DPI Grayscale

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Owners and Operation Manuals

a. O & M's shall be turned over by the Contractor.

b. PDF Creation: Each book of specifications shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 200 DPI Grayscale

ii) Bookmarking: Bookmarking of O & M Manuals shall be extensive.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Division 23 Sections, including single phase and three phase electric motors.

B. Power factor correction.

C. Drives.

1.2 RELATED SECTIONS

A. 23 05 00 – Common Work Results for HVAC Equipment.

B. 23-05 16 – Expansion Fittings and Loops for HVAC Piping.

C. 23 21 23 – Hydronic Pumps.

D. 23 34 13 – Fans.

E. 23 36 00 – Air Terminal Units.

F. 23 52 38 – Condensing Boilers.

G. 23 72 13 – Heat-Wheel Air-to-Air Energy Recovery.

H. 23 74 13 – Packaged, Outdoor Roof-Top Units.

I. 23 74 33 – Packaged Outdoor Roof-Top Heating and Cooling Make-Up Air Units.

J. 23 82 33 – Convectors.

K. 23 82 39 – Unit Heaters.

1.3 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. NEMA MG 1 - Motors and Generators.

D. NEMA MG 30 & 31.

E. NFPA 70 - National Electrical Code.

F. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

G. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

1.5 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals.

B. Shop Drawings:

1. Include manufacturer's product and nameplate data.
2. Include physical and performance data.
3. When used with variable frequency drive; certification that motor is compatible.
4. Include selection data for power factor correction capacitors.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the site.

B. Accept controllers on site in original packing. Inspect for damage.

C. Store in a clean, dry, environmentally-controlled space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.

D. Handle in accordance to the manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure and finish

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not store or install unless temperature in maintained between 32 degrees F and 104 degrees F, at a relative humidity less than 95 percent (non-condensing).

B. Maintain conditions during and after installation of Products.

1.9 WARRANTY

A. Section 23 05 00 - Warranties.

B. Provide a complete parts and labor warranty on the VFD system and all related accessories, commencing on the date of final acceptance and continue for a period of two (2) years. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse, or misuse) at no charge to the Owner during this time period

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

A. Manufacturers:

1. Baldor.
2. General Electric.
3. Marathon.
4. Reliance.
5. Substitutions: Refer to Section 23 05 00.

B. General:

1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
2. Single Phase Motors: PSC for low starting torque, direct drive applications. Capacitor start for high starting torque applications.
3. Electrical Service (unless noted otherwise):
    a. Motors Smaller than 1/2 HP: single phase, 60 Hz.
    b. Motors 1/2 HP and Larger: three phase, 60 Hz.
    c. Refer to the Schedules on Drawings for voltage.
4. Motors to be started across-the-line, unless noted otherwise, or as noted below:
    a. 208-240 Volt: Part winding start for motors 25 HP and above.
    b. 480 Volt: Part winding start for motors 50 HP and above.
5. Open drip-proof (ODP) type except where specifically noted otherwise.
6. Totally enclosed fan cooled (TEFC), TEAO or TENV motors when exposed to the weather.
7. Design for continuous operation in 40 degrees C environment.
8. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
9. Explosion-Proof Motors: Class 1, Group D; and Class II, Group E, F and G.
10. Visible Nameplate: Indicating manufacturer's name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.
11. Wiring Terminations:
    a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
    b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
12. Motor Efficiencies
    a. Efficiency: NEMA Premium Efficiency (1 hp and larger). Follow NEMA Standards Publication MG 1-2003, in Tables 12-12 and 12-13.
    b. Exception: Motors on sump pumps, sewage ejectors, fire pumps, smoke exhaust fans and stairway pressurization.
13. Motors for use with Variable Frequency Drives
    a. NEMA Standard MG1 definite purpose inverter duty rated motors shall be used for all IGBT Pulse Width Modulated drive installations. Inverter duty motors shall be designed and manufactured to meet NEMA Standard MG1 for definite purpose inverter duty motors. The inverter duty motors shall be able to withstand voltages greater than 1600 volts peak and rise times of 0.1 microsecond.
    b. Insulated of isolated bearings shall be used for the inverter duty rated motors.

c. The inverter duty motor insulation class shall be class F insulation and a class B temperature rise based on 40 degrees C.

d. The inverter duty motor name plate shall indicate that the motor is an inverter duty motor.

e. Provide factory installed shaft ground ring.

C. Single phase: Motor shall be an electronically commutated motor rated for continuous duty and furnished with internally mounted potentiometer speed controller suitable for speed control. Capacitor motors shall not be used when ECM is specified.

D. Single Phase Power - Permanent Split Capacitor Motors:

1. Starting Torque: Exceeding one fourth of full load torque.
2. Starting Current: Up to six times full load current.
3. Multiple Speed: Through tapped windings.
4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Single Phase Power - Capacitor Start Motors:

1. Starting Torque: Three times full load torque.
2. Starting Current: Less than five times full load current.
3. Pull-up Torque: Up to 350 percent of full load torque.
4. Breakdown Torque: Approximately 250 percent of full load torque.
5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve bearings.
7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

F. Three Phase Power - Squirrel Cage Motors:

1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
5. Insulation System: NEMA Class F with Class B rise.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Weatherproof TEFC Motors: Epoxy seal windings using vacuum and pressure or coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.2 POWER FACTOR CORRECTION

A. Manufacturers:
   1. Cornell-Dubelier.
   2. General Electric.
   3. Ronk Electrical Industries.
   4. Sprague.
   5. Westinghouse.
   6. Zucker.

B. Provide power factor correction capacitors for motors 3 horsepower or larger in accordance with the following requirements. Capacitors shall be selected so that they do not overcorrect the power factor beyond 99.99% throughout the range of operation of the motor. Reference to "full load" means the rated motor horsepower not including the service factor.
   1. Motors with Constant Load: Correct to a minimum 95% power factor when operating at 65% of full load.
   2. Direct Expansion Refrigeration Compressors: correct compressors to a minimum of 95% power factor when operating in its least loaded condition.

C. Motors that operate during emergency situations only, such as smoke exhaust fans and stairway pressurization fans, may be excluded from power factor correction. In addition, motors connected to variable speed drives shall be excluded from the power factor correction requirements.

D. If equipment is furnished with a control panel, that panel shall come with power factor correction capacitors factory installed and wired.

E. For equipment that does not have a control panel, the equipment supplier shall be responsible for furnishing the capacitors and installing them at either the motor disconnect or motor control center.

F. Individual capacitors shall be dry electrolytic type and enclosed in integrated dust tight enclosure.

2.3 MOTOR CONTROLLERS

A. In general, motor controllers will be furnished and installed under Division 26 unless the motor controller is an integral part of a piece of equipment, or noted otherwise.

B. Where control components are factory furnished, a control transformer with fused secondary shall be provided to reduce voltage to 120 volts to operate control and safety devices.

2.4 BELT DRIVES

A. V-belt drives for equipment with motors smaller than 3 horsepower shall be rated for 150% of rated horsepower of the driven equipment with matched pulleys and belts. V-belt drives for equipment with motors 3 horsepower and larger shall be rated for 200%.

B. Variable pitch drives shall be selected so that the fan speed at the specified operating conditions is approximately centered on the sheave adjustment range.

C. Exposed belt drives shall have OSHA approved guards to completely enclose sheaves and belts. Guards shall be constructed of expanded metal and reinforced with angle iron and securely fastened to floor or base. Provide openings at motor and driven equipment shafts for taking tachometer readings.

D. Except as specified otherwise, provide variable sheaves for motors 15 HP and smaller and fixed sheaves for motors 20 HP and larger.

E. Where motors are used with variable frequency drive systems, provide fixed sheaves. Select sheaves at an RPM which will provide 15 percent greater capacity that called out on drawings. Final capacity adjustments will be made with the variable frequency drive system.

F. Belt driven equipment shall include an adjustable motor base for adjusting belt tension.

PART 3 EXECUTION

3.1 COORDINATION

A. Provide the necessary control interface that will accept and understand the input from the controlling entity. Verify the interface requirements with the temperature control contractor.

3.2 INSTALLATION

A. Install motors, power factor correction capacitors, and drives in accordance with manufacturer’s instructions.

B. Power factor correction capacitors wired to motor starters by Division 26.

C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

D. Check line voltage and phase and ensure agreement with nameplate.

E. Check rotation of motor driven equipment and lubricate as recommended by manufacturer.

F. Align all drive systems and adjust belt tension. Remove pulley set screws, install thread locking substance on threads, and reinstall screws, torquing to manufacturer's specifications.

G. Check and adjust belt guards so that no parts are in contact with rotating equipment.

H. All motors on pumps shall be laser aligned by a factory authorized service technician.

3.3 DEMONSTRATION

A. Fully instruct the Owner's personnel as to the proper operation of the equipment.

END OF SECTION

SECTION 23 05 16

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

C. Section 23 23 13 - Refrigerant Piping, Valves and Specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include adjustment instructions.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Provide year warranty under provisions of Section 23 05 00.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Adsco.
2. Flexonics.
3. Keflex.
4. Metra-Flex.
5. Minnesota Flexible Corp.
6. Substitutions: Refer to Section 23 05 00.

B. Steel Piping:

1. Manufacturers: Flexonics [BSN] [PCS].
2. Inner Hose: Stainless Steel.
3. Exterior Sleeve: Braided stainless steel.
4. [Pressure Rating for Flexonics BSN, single braided: 390 psig WSP @ 70 degrees F for 2" pipe. 270 psig WSP @ 70 degrees F for 4" pipe.]
5. [Pressure Rating for Flexonics PCS, single braided: 450 psig WSP @ 70 degrees F for 2" pipe. 285 psig WSP @ 70 degrees F for 4" pipe. 165 psig WSP @ 70 degrees F for 10" pipe.]
6. Joint: Flanged, threaded or welded as specified for pipe joints.
7. Size: Use pipe sized units.
8. Maximum offset: 3/4 inch on each side of installed center line.
9. Length: Flange size plus 10 inches.

C. Copper Piping:

1. Manufacturers:
   a. Flexonics Series 301.
2. Inner Hose: Bronze
3. Exterior Sleeve: Braided bronze.
4. Pressure Rating: 735 psig WSP @ 70 degrees F for 1/2" pipe. 460 psig WSP @ 70 degrees F for 1" pipe. 280 psig WSP @ 70 degrees F for 2" pipe.]
5. Joint: Flanged, threaded or welded as specified for pipe joints.
6. Size: Use pipe sized units.
7. Maximum offset: 3/4 inch on each side of installed center line.
8. Length: Flange size plus 10 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 FLEXIBLE PIPE CONNECTORS

A. Construct spool pieces to exact size of flexible connection for future insertion.

B. Provide flexible connectors on pipes connected to equipment supported by vibration isolation. Provide on pumps.

C. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

END OF SECTION

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and Pressure gage taps.

B. Thermometers and thermometer wells.

C. Test plugs.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

1.3 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM E1 - Standard Specification for ASTM Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals.

B. Product Data: Provide manufacturers data [and list] which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of components and instrumentation.

C. Operation and Maintenance Data: Include instructions for calibrating instruments.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.7 MAINTENANCE PRODUCTS

A. Supply two bottles of red gage oil for static pressure gages.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturer: Trerice No.750 Series.

B. Other acceptable Manufacturers:

1. Ashcroft.
2. Crosby.
3. Marsh.
4. U.S. Gauge

5. Weiss
6. Substitutions: Refer to Section 23 05 00.

C. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front recalibration adjustment, black scale on white background.

1. Case: Cast aluminum.
2. Bourdon Tube: Brass.
3. Dial Size: 4-1/2 inch diameter.
4. Mid-Scale Accuracy: One percent.
5. Scale: Psi.

2.2 STEM TYPE THERMOMETERS

A. Manufacturer: Trerice Model BX93000.

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 23 05 00.

C. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.3 SOLAR POWERED THERMOMETERS

A. Manufacturer: Trerice Model SX9 Series (Interior).

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 23 05 00.

C. Thermometer: ASTM E1, adjustable angle, LED Solar activated, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.

3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required[, and with cap and chain].

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Test Plug:

1. Manufacturers:
   a. Pete's Plug.
   b. Sisco.
   c. Substitutions: Refer to Section 23 05 00.
2. 1/4 inch fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
   a. Neoprene core for temperatures up to 200 degrees F.
   b. Nordel core for temperatures up to 350 degrees F.
   c. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a. Two 3-1/2 inch diameter pressure gages.
      1) Scaled for each range required
   b. Two gage adapters with 1/8 inch probes.
   c. Two 1-1/2 inch dial thermometers.
      1) Scale range: 25 to 125 degrees F.
      2) Scale range: 50 to 500 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install one pressure gage per pump, with taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping.

C. Install pressure gages with pulsation dampers. Provide ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide the following thermometer temperature ranges unless noted otherwise:

1. Heating hot water; 30-240 degrees F.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale.

I. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

J. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

K. Locate test plugs where indicated.

3.2 SCHEDULES

A. Pressure Gages.

1. Pumps - inlets and outlets.
2. Pressure reducing valves - inlet and outlet.
3. Other locations as shown on drawings.

B. Pressure Gage Tapping Location:

1. Control valves 3/4 inch & larger - inlets and outlets.
2. Boiler - inlets and outlets.
3. Other locations as shown on drawings.

C. Stem Type Thermometers:

1. Headers to central equipment.
2. Heat exchangers - inlets and outlets.
3. Boilers - inlets and outlets.
4. Water zone supply and return.
5. Other locations shown on drawings.

D. Thermometer Socket Location:

1. Control valves 1 inch & larger - inlets and outlets.

END OF SECTION

SECTION 23 05 23

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valves for hydronic and steam piping systems.

1. Ball.
2. Butterfly.
3. Swing Check.
4. Wafer Silent Check.
5. Drain (Same as Ball valves)

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 20 13 - Hydronic Piping.

1.3 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide data on valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 23 05 00.

B. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC IX.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 BALL VALVES - (150 PSIG)

A. Up to and including 3 inches:

1. Manufacturer: Apollo 77-140/77-240 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Victaulic
    g. Substitutions: Refer to Section 23 05 00.
2. Construction: Class 150, 600 psig wog, bronze, two piece body, stainless steel ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union if next to control valve or equipment. Extended stems for use on insulated pipe.

B. Up to and including 3 inches:
1. Manufacturer: Apollo 82-140/82-240 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Victaulic
    g. Substitutions: Refer to Section 23 05 00.
2. Construction: Class 150, 600 psig wog, bronze, three piece body, stainless steel ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union if next to control valve or equipment. Extended stems for use on insulated pipe.

2.2 BUTTERFLY VALVES - (150 PSIG)

A. Manufacturer: Bray series 31:
1. Centerline.
2. Crane.
3. Hammond.
4. Kitz.
5. Milwaukee.
6. Nibco.
7. Victaulic.
8. Substitutions: Refer to Section 23 05 00.

B. Construction 1-1/2 inches and Larger: MSS SP-67, ANSI 150 rating, ductile iron body, flanged, lug or grooved ends, extended neck.

C. 316 Stainless steel disc.

D. Resilient EPDM seat, 100% bubble tight shut off to 150 psi.

E. Valves 5 inches and smaller, used for shut off service, shall have a latch-lock handle. When used for throttling or located above 8'-0" AFF, valves shall have worm screw enclosed operator with position indicator and adjustable stop.

F. Valves 6 inches and larger shall have worm screw enclosed operator with positive indicator, and adjustable stop.

G. Provide chain-wheel operators for valves mounted over 8 feet above floor.

2.3 SWING CHECK VALVES - (150 PSIG)

A. Up To and Including 2 inches:

1. Manufacturers: Stockham Model B-309/B-319, or equivalent by:
   a. Hammond.
   b. Bray.
   c. Kitz.
   d. Milwaukee.
   e. Nibco.
   f. Watts Regulator.
   g. Victaulic.
   h. Substitutions: Refer to Section 23 05 00.
2. Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded or grooved ends.

B. 2-1/2 inches and Larger:

1. Manufacturers: Stockham Model G-931, or equivalent by:
   a. Hammond.
   b. Bray.
   c. Kitz.
   d. Milwaukee.
   e. Nibco.
   f. Watts Regulator.
   g. Victaulic.
   h. Substitutions: Refer to Section 23 05 00.
2. Class 125, 3 percent nickel cast iron body and disc, stainless steel seat and pin, flanged or grooved connections.

2.4 WAFER STYLE SILENT CHECK VALVES - HYDRONIC (150 & 300 PSIG)

A. 3 inches and Larger:

1. Manufacturers: Crane Model Duo-Chek II
   a. Mueller.

b. Titan

c. Spence

d. Substitutions: Refer to Section 23 05 00.

2. ANSI Class 150 and 300, carbon steel wafer or flanged type body, 316 stainless steel plates and springs with Buna-N insert seat.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All grooved products shall be of the same manufacturer.

C. Provide access where valves and fittings are not exposed.

D. Install valves with stems upright or horizontal, not inverted.

3.3 APPLICATION

A. Install all handles for valving overhead on the side of the pipe to allow access. Do not install on top of pipe or bottom of pipe. Verify handle has clearances for operating and replacement.

B. Hand wheels shall be a minimum of 6” diameter on valves 6” diameter and smaller, 10” diameter hand wheels on valves 8” thru 14”and 16” diameter hand wheels on valves 18” and larger.

C. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

D. Use butterfly valves on heating water systems.

E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

F. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

G. Provide wafer style silent check valves on discharge of base mounted water pumps if triple duty valve is not used.

H. Provide swing style check valves on discharge of inline water pumps.

I. Provide High Performance Butterfly valves on heating system.

END OF SECTION

SECTION 23 05 29

HANGERS & SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, ductwork, and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 07 19 – HVAC Piping Insulation

C. Section 23 20 13 - Hydronic Piping.

D. Section 23 23 13 - Refrigerant Piping, Valves and Specialties.

E. Section 23 22 13 - Section 23 31 13 – Metal and Non-Metal Ductwork Casing and Plenums.

1.3 REFERENCES

A. ASME B31.1 - Power Piping

B. ASME B31.5 - Refrigeration Piping

C. ASME B31.9 - Building Services Piping

1.4 SUBMITTALS

A. Shop Drawings: Indicate system layout with locations and details of all types of hangers.

B. Product Data: Provide manufacturers catalog data including load capacity.

C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of hydronic and refrigerant piping, and ductwork.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Anvil.
2. B-Line Systems.
3. Michigan.
4. Tolco.
5. Substitutions: Under provisions of Section 23 05 00.

B. Hydronic Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, and split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Refrigerant Piping:

1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Stainless steel in areas of high humidity.

2.3 INSERTS

A. Manufacturers: Anvil Figure 282 (8 inches and smaller). Anvil Figure 282 with Figure 66 attachment (larger than 8 inches). Other acceptable manufacturers offering equivalent products.

1. B-Line Systems.

2. Michigan.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 DUCT HANGERS AND SUPPORTS

A. Hangers: Galvanized steel band iron or rolled angle and 3/8 inch diameter rods. Fastenings and hardware to be cadmium plated or stainless steel.

B. Wall Supports: Galvanized steel band iron or fabricated angle bracket.

C. Vertical Supports: Rolled angles at floor.

D. High Humidity Areas: Aluminum or stainless steel hangers, wall supports, vertical wall supports, fastenings and hardware.

2.5 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb/sq ft sheet lead

2. Soundproofing: 1 lb/sq ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Pipes in building walls below grade: modular wall seal.

E. Sleeves for Round Ductwork: Galvanized steel.

F. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

G. Stuffing and Fire stopping Insulation: Glass fiber type, non-combustible.

H. Sealant: Acrylic.

2.7 FIRESTOP SYSTEMS

A. Manufacturer:

1. 3M (Minnesota Mining and Manufacturing Co.).

2. Hilti.

3. Substitutions: Under provisions of Section 23 05 00.

B. Firestop systems that are produced and installed to resist the spread of fire according to requirements indicated, resist passage of smoke and other gasses, and maintain original fire-resistance rating of construction assembly.

C. Certificate of conformance for through-penetration requirements of ASTM E814 and UL1479.

D. Systems or devices listed in the UL Fire Resistance Directory under category XHCR (firestop devices) and XHEZ (firestop systems) may be used, providing that they conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system in symmetrical for wall applications.

E. Accessories include, but are not limited to; permanent forming/damming/backing materials, temporary forming materials, substrate primers, and collars and steel sleeves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support vertical piping at every floor.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Hangers for insulated pipe shall be large enough to encompass the insulation and the metal protective shield.

L. Support piping from building structure. Do not support piping from other mechanical or electrical components.

M. Do not support piping with wire or metal stripping hangers.

3.4 DUCT HANGERS AND SUPPORTS

A. Support ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Chapter 4, Hangers and Supports.

3.5 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Provide for all floor mounted mechanical equipment.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.

C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

D. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch above finished floor level. Sleeves in mechanical room floor slabs shall extend 6 inches above finished floor level. Calk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and calk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.8 FIRE STOP SYSTEMS

A. Provide firestop systems for pipe and duct through-penetrations of the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items: floor and ceilings, walls and partitions, smoke barriers, and construction enclosed compartmentalized areas.

B. Install through-penetration firestop systems to comply with manufacturer’s written installation instructions.

3.9 SCHEDULES

A. Piping:

PIPE SIZE Inches	MAX. HANGER SPACING (**) Feet	HANGER ROD DIAMETER Inches
Copper:		
1/2 to 1-1/4	6	3/8
1-1/2 to 4	10	3/8
5 and larger	10	1/2
Steel:		
1/2 to 3/4	10	3/8
1 to 4	12	3/8
5 to 8	12	1/2
10 to 12	12	5/8

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vibration isolators.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 29 - Hangers & Supports for HVAC Piping, Ductwork and Equipment.

C. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping.

1.3 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping and ductwork.

B. Provide minimum static deflection of isolators for equipment as indicated in schedule.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Locate vibration isolators, with static and dynamic load on each.

C. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

D. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Vibration Isolation

1. Flexonics
2. Korfund
3. Mason Industries.
4. Vibration Eliminator Co.
5. Vibration Mountings and Controls.
6. Substitutions: Under provisions of Section 23 05 00.

2.2 VIBRATION ISOLATORS

A. Open Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Restrained Closed Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

E. Spring Hanger:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.

4. Misalignment: Capable of 20 degree hanger rod misalignment.

F. Neoprene Pad Isolators:

1. Rubber or neoprene waffle pads.

a. 30 durometer.

b. Minimum ½ inch thick.

c. Maximum loading 40 psi.

d. Height of ribs shall not exceed 0.7 times width.

2. Configuration: Single layer. 1/2 inch thick waffle pads bonded each side of ¼ inch thick steel plate.

G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

2.3 PUMP CONNECTORS:

A. Flexible metal hose.

B. 2 inches and smaller: threaded ends, braided phosphor bronze, annular correlations, 250 psig working pressure, 450 F operating temperature.

C. 2 1/2 inches and larger: flanged ends, braided stainless steel, annular correlations, 250 psig working pressure, 450 F operating temperature.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install isolation for motor driven equipment.

C. Install spring hangers without binding.

D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

F. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.

G. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector. as follows:

1. Up to 4 inch Diameter: First three points of support.
2. 5 to 8 inch Diameter: First four points of support.
3. 10 inch Diameter and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

H. Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.3 EQUIPMENT ISOLATION SCHEDULE

A. Floor mounted fans and factory assembled air handling units: open spring isolator with 1 1/2" deflection and thrust restraint. Use concrete inertia base for fans in excess of 3.5 inch WC or motors in excess of 40 HP.

B. Suspended fans 1 HP and smaller: rubber hanger.

C. Suspended fans and air handling units: open spring hanger with 1 1/2 inch deflection.

D. Roof mounted fans, condensers and condensing units: restrained closed spring isolators with 1 ½ inch deflection.

E. Base mounted pumps 10 HP and smaller: pump connectors.

F. Base mounted pumps greater than 10 HP, or on other than lowest level of building: pump connectors with inertia base.

G. Centrifugal chiller: restrained spring isolators (manufacturer's instructions for deflection).

H. Cooling tower: restrained closed spring isolators (manufacturer's instructions for deflection).

I. Isolated piping connected to equipment: spring hanger.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling Tacks.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

1.3 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Submit list of wording, symbols, letter size, and color coding proposed for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two tags, 1-1/2 inches in size.

F. Samples: Submit two labels, 1.9 x 0.75 inches in size.

G. Manufacturer's Instructions: Indicate installation instructions, special procedures, and installation.

H. Samples: Submit two (2) signs each, 9” x 7” and 6” x 2” size.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

C. Valve Tag Chart.

1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/OSHA.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Seton.

2. Brady.

3. Substitutions: Refer to Section 23 05 00.

B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 23 05 00.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 23 05 00.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with smooth edges.

C. Tag Chart: Typewritten letter size list plastic laminated.

2.3 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Ductwork and Equipment: 2 inch high letters.

B. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Pipe Markers:

1. Manufacturers:

a. Brady.

b. Seton.

c. Substitutions: Refer to Section 23 05 00.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. No tape or adhesive necessary. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Markline.

b. Substitutions: Refer to Section 23 05 00.

2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS.

A. Manufacturer: Moore.

B. Other acceptable manufacturers offering equivalent products.

1. Substitutions: Refer to Section 23 05 00.

C. Description: Steel with ¾ inch diameter color coded head.

D. Color code as follows:

1. HVAC (equipment and valves): Yellow.

2. Fire dampers/smoke damper/sprinkler shut off valve/duct smoke detector: Red.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags and signs using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify air terminal units and radiator valves with numbered tags.

J. Tag automatic controls, instruments, and relays. Key to control schematic.

K. Identify piping, concealed or exposed, with plastic pipe markers . Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Identification:

1. Piping: Use pipe service description and color schemes that are standard to the manufacturer.
2. Equipment: Use nomenclature as noted on the drawings.
3. Ductwork: Use description as noted on the drawings.
4. Underground Utilities: Use nomenclature as noted on the drawings.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of new air systems.

B. Testing, adjustment, and balancing of new hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Sound measurement of equipment operating conditions.

E. Vibration measurement of equipment operating conditions.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

C. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

D. Prior to commencing work, submit detailed procedures, agenda, sample report forms.

E. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, forms prepared following ASHRAE 111, NEBB forms, containing information indicated in Schedules.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of flow measuring stations, balancing valves and rough setting.

1.6 QUALITY ASSURANCE

A. Services provided by independent qualified Testing and Balancing Agency.

B. Provide services to Mechanical Contractor.

C. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.7 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years documented experience, certified by AABC or NEBB.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.8 SEQUENCING

A. Sequence work under the provisions of Section 23 05 00.

B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 SCHEDULING

A. Schedule work under the provisions of Section 23 05 00.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operable before commencing work.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems. Adjust outside air to within 0 to plus 10 percent of design.

B. Heat Recovery Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

C. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

D. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, outside air, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets with direct reading velocity meters or flow hoods in accordance with manufacturers instructions.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required, including belts and pulleys. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air, minimum outside air, return air, relief air and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Verify operation of temperature control dampers to assure shut-off and proper position with controller. Make adjustments if necessary.

M. Measure building static pressure and adjust supply, return, relief and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated circuit balancing valves, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

Air Coils
Air Cooled Refrigerant Condensing Units
Air Handling Units
Air Inlets and Outlets
Boilers - Packaged Steel Water Tube
Energy Recovery Equipment
Fans
Heat Exchangers
Packaged Roof Top Heating/Cooling Units
Pumps - HVAC
Terminal Heat Transfer Units

B. Report Forms

1. Title Page:
   a. Name, Address and Telephone Number of Testing, Adjusting, and Balancing Agency
   b. Project name
   c. Project location
   d. Project Architect
   e. Project Engineer
   f. Project Contractor
   g. Project altitude
   h. Report date
2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence
   d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
   e. Nomenclature used throughout report
   f. Test conditions

3. Instrument List:
    a. Instrument
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Range
    f. Calibration date
4. Electric Motors:
    a. Manufacturer
    b. Model/Frame
    c. HP/BHP
    d. Phase, voltage, amperage; nameplate, actual, no load
    e. RPM
    f. Service factor
    g. Starter size, rating, heater elements
    h. Sheave Make/Size/Bore
5. V-Belt Drive:
    a. Identification/location
    b. Required driven RPM
    c. Driven sheave, diameter and RPM
    d. Belt, size and quantity
    e. Motor sheave diameter and RPM
    f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller
    e. Service
    f. Design flow rate, pressure drop, BHP
    g. Actual flow rate, pressure drop, BHP
    h. Discharge pressure
    i. Suction pressure
    j. Total operating head pressure
    k. Shut off, discharge and suction pressures

l. Shut off, total head pressure

m. Variable flow pumps: Flow rate, pressure drop, RPM, BHP, from design flow rate to VFD minimum in 10% increments.

7. Combustion Test:

a. Burner manufacturer

b. Model number

c. Serial number

d. Firing rate

e. Overfire draft

f. Gas meter timing dial size

g. Gas meter time per revolution

h. Gas pressure at meter outlet

i. Gas flow rate

j. Heat input

k. Burner manifold gas pressure

l. Percent carbon monoxide (CO)

m. Percent carbon dioxide (CO2)

n. Percent oxygen (O2)

o. Percent excess air

p. Flue gas temperature at outlet

q. Ambient temperature

r. Net stack temperature

s. Percent stack loss

t. Percent combustion efficiency

u. Heat output

8. Air Moving Equipment

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Arrangement/Class/Discharge

f. Air flow, specified and actual

g. Return air flow, specified and actual

h. Outside air flow, specified and actual

i. Total static pressure (total external), specified and actual

j. Inlet pressure

k. Discharge pressure

l. Sheave Make/Size/Bore

m. Number of Belts/Make/Size

n. Fan RPM

o. Variable flow fans: CFM, static pressure, RPM, BHP, from design cfm to VFD minimum in 10% increments.

9. Return Air/Outside Air Data:

a. Identification/location

b. Design air flow

c. Actual air flow

d. Design return air flow

e. Actual return air flow

f. Design outside air flow

g. Actual outside air flow

h. Return air temperature

i. Outside air temperature

j. Required mixed air temperature

k. Actual mixed air temperature

l. Design outside/return air ratio

m. Actual outside/return air ratio

n. Variable flow fans: Track supply fan cfm from maximum to minimum air flows maintaining building pressurization and minimum outside air.

10. Exhaust Fan Data:

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Air flow, specified and actual

f. Total static pressure (total external), specified and actual

g. Inlet pressure

h. Discharge pressure

i. Sheave Make/Size/Bore

j. Number of Belts/Make/Size

k. Fan RPM

11. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor
12. Duct Leak Test:
    a. Description of ductwork under test
    b. Duct design operating pressure
    c. Duct design test static pressure
    d. Duct capacity, air flow
    e. Maximum allowable leakage duct capacity times leak factor
    f. Test apparatus
        1) Blower
        2) Orifice, tube size
        3) Orifice size
        4) Calibrated
    g. Test static pressure
    h. Test orifice differential pressure
    i. Leakage
13. Flow Measuring Station (CBV, Venturi, etc.):
    a. Identification/number
    b. Location
    c. Size
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Design Flow rate
    h. Design pressure drop
    i. Actual/final pressure drop

j. Actual/final flow rate

k. Station calibrated setting

14. Air Distribution Test Sheet:

a. Air terminal number

b. Room number/location

c. Terminal type

d. Terminal size

e. Area factor

f. Design velocity

g. Design air flow

h. Test (final) velocity

i. Test (final) air flow

j. Percent of design air flow

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ductwork insulation.

B. Duct Liner.

C. Insulation jackets.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 31 13 – Metal and Non-Metal Ductwork Casing and Plenums: Duct liner.

1.3 REFERENCES

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

C. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. NAIMA National Insulation Standards.

F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

G. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.

B. Conform to ASTM Standards for “k” value, moisture vapor transmission, maximum moisture absorption, jacket, insulating cement, and adhesive.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER, FLEXIBLE

A. Manufacturer: Johns-Manville 800 Series Spin-Glas

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.
2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C553; flexible, noncombustible blanket.

1. ‘K’ value: .24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F unfaced side, 150 degrees F faced side.
3. Maximum moisture absorption: less than 5 percent by weight.

D. Vapor Barrier Jacket:

1. FSK facing.
2. Moisture vapor transmission: 0.02 perm.
3. Secure with pressure sensitive tape.

E. Vapor Barrier Tape:

1. FSK facing, with pressure sensitive rubber based adhesive.

F. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G. Tie Wire: Annealed steel, 16 gage.

2.2 GLASS FIBER, RIGID

A. Manufacturer: Johns-Manville 800 Series Spin-Glas.

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.

2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C612; rigid, noncombustible blanket.
1. 'K' value: 0.24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F unfaced side, 150 degrees F faced side.
3. Maximum moisture absorption: less than 1% by volume.
4. Density: 3.0 lb/cu ft.

D. Vapor Barrier Jacket:
1. FSK facing.
2. Moisture vapor transmission: 0.02 perm.
3. Secure with pressure sensitive tape.

E. Vapor Barrier Tape:
1. FSK facing, with pressure sensitive rubber based adhesive.

2.3 GLASS FIBER DUCT LINER, FLEXIBLE

A. Manufacturer: Johns-Manville Permacote Linacoustic RC.

B. Other acceptable manufacturers offering equivalent products:
1. CertanTeed.
2. Knauf
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C1071; flexible, noncombustible blanket with acrylic polymer impregnated surface and edge coat.
1. 'K' Value: maximum 0.24 at 75 degrees F for 1" thickness.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Velocity on Coated Air Side: 5,000 fpm.
4. Minimum Noise Reduction Criteria: 0.55 for 1/2 inch thickness, 0.70 for 1 inch thickness, 0.85 for 1-1/2 inch thickness, 0.95 for 2 inch thickness.

D. Adhesive:
1. Waterproof, fire-retardant type.

E. Liner Fasteners: Galvanized steel, with press-on head.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Insulate ductwork conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulate ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces below 10 feet above finished floor: Finish with canvas jacket sized for finish painting.

E. Exterior Applications: Provide insulation with weatherproof vapor barrier jacket. Cover with caulked aluminum waterproof jacket with seams located on bottom side of horizontal duct section.

F. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct Liner Application:

1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Exhaust and Relief Air Ducts Within 10 ft of Exterior Openings (except for kitchen range hood exhaust systems):

1. Flexible Glass Fiber Blanket – external (concealed areas only): 1-1/2 inches thick.
2. Rigid Glass Fiber - external: 1 inch thick.

3. Flexible Glass Fiber Duct Liner: 1-1/2 inches thick.

B. Mixed Air Ducts:
   1. Flexible Glass Fiber Blanket – external (concealed areas only): 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 1/2 inches thick.

C. Outside Air Intake Ducts:
   1. Flexible Glass Fiber Blanket – external (concealed areas only): 3 inches thick.
   2. Rigid Glass Fiber - external: 2 inches thick.

D. Relief Ducts - Concealed:
   1. Flexible Glass Fiber Blanket - external: 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 inch thick.

E. Relief Ducts – Exposed (non-conditioned spaces):
   1. Rigid Glass Fiber - external: 1 inch thick.

F. Relief Ducts – Exposed (conditioned spaces):
   1. No insulation.

G. Return Ducts - Concealed:
   1. Flexible Glass Fiber Blanket - external: 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 inch thick.
   3. Flexible Glass Fiber Duct Liner: 1 inch thick.

H. Return Ducts - Exposed:
   1. Rigid Glass Fiber - external: 1 inch thick.
   2. Flexible Glass Fiber Duct Liner: 1 inch thick.

I. Supply Ducts - Concealed:
   1. Flexible Glass Fiber Blanket - external: 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 inch thick.

J. Supply Ducts – Exposed (non-conditioned spaces):
   1. Rigid Glass Fiber - external: 1 inch thick.

K. Supply Ducts – Exposed (conditioned spaces):
   1. No insulation.

L. Transfer Ducts:
   1. Flexible Glass Fiber Duct Liner: 1/2 inch thick.

M. Ducts Exposed to Outdoors:
   1. Rigid Glass Fiber - external: 2 inches thick.
   2. Flexible Glass Fiber Duct Liner: 2 inch thick.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 20 13 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 23 13 - Refrigerant Piping, Valves and Specialties: Placement of inserts.

1.3 REFERENCES

A. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

B. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. NAIMA National Insulation Standards.

E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.

B. Conform to ASTM Standards for “k” value, moisture vapor transmission, maximum moisture absorption, jacket, insulating cement, and adhesive.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER

A. Manufacturer: Johns Manville Micro-Lok HP.

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.
2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket:

1. White kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.2 CELLULAR FOAM

A. Manufacturer: Armacell AP Armaflex.

B. Other acceptable manufacturers offering equivalent products:

1. IMCOA/Nomaco.
2. Rubatex.
3. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C534; flexible, cellular elastomeric (or unicellular polyolefin), molded or sheet.

1. 'K' Value: 0.25 at 75 degrees F.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Maximum Moisture Absorption: 5 percent by weight.

5. Moisture Vapor Transmission: 0.10 perm-inches.
6. Connection: Waterproof vapor barrier adhesive.
7. Flame Spread: 25. Smoke Developed: 50.

D. Adhesive: Air dried, contact adhesive, compatible with insulation.

2.3 JACKETS

A. PVC Plastic:

1. Manufacturers:
   a. Zeston.
   b. Proto Corp.
   c. Substitutions: Refer to Section 23 05 00.
2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: -40 degrees F.
   b. Maximum Service Temperature: 150 degrees F.
   c. Moisture Vapor Transmission: 0.002 perm-inches.
   d. Thickness: 10 mil minimum (use standard stock dimensions).
   e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic:
   a. Compatible with insulation.

B. Aluminum Jacket:

1. Thickness: .025 inch sheet.
2. Finish: Stucco embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Metal Jacket Bands: 3/8-inch-wide; 0.015-inch-thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and under the finish jacket.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 23 05 29.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces less than 10 feet above finished floor: Finish with PVC jacket and fitting covers.

K. Exterior Applications: Increase scheduled insulation thickness by 1/2 inch. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES – BASED ON MINNESOTA ENERGY CODE

A. Heating Systems:

1. Hot Water (140 degrees F maximum):

a. Glass Fiber Insulation:

1) Pipe Size Range: 1-1/4 inch and less, 1-1/2 inch and larger.

2) Thickness: 1 inch, 1-1/2 inch.

2. Hot Water (141 to 200 degrees F):

a. Glass Fiber Insulation:

1) Pipe Size Range: 1-1/4 inch and less, 1-1/2 inch and larger.

2) Thickness: 1-1/2 inch, 2 inch.

B. Cooling Systems:

1. Condensate Drains from Cooling Coils:

a. Glass Fiber Insulation:

1) Thickness: 1/2 inch.

b. Cellular Foam: (not for use in air plenum ceilings).

1) Pipe Size Range: 2 inches and less.

2) Thickness: 3/4 inch.

2. Refrigerant Suction and Hot Gas:

a. Glass Fiber Insulation:

1) Pipe Size Range: all sizes.

2) Thickness: 1 inch.

b. Cellular Foam: (not for use in air plenum ceilings).

1) Pipe Size Range: 2 inches and less.

2) Thickness: 1 inch.

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1-GENERAL

1.1 DEFINITION

A. The Commissioning Authority will be an independent agency (separate from this Contract) selected by the Owner to perform the Work outlined in the Contract Documents.

B. The Work shall include coordination and documentation of all Verification and Functional Performance Test procedures on new and modified mechanical ventilation equipment and systems to ensure operation and performance.

C. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions.

D. Commissioning work shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance parameters for fine tuning of control sequences and operational procedures. Commissioning shall coordinate system documentation, equipment start-up, control system calibration, testing and balancing, and Verification and Functional Performance Testing.

E. The commissioning team shall be made up of representatives from the Owner, design professionals, major equipment suppliers, and construction trades. The trades represented on the commissioning team shall include, but not be limited to, sheet metal, piping and fitting, controls, test and balance, and electrical. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the commissioning team. Responsibility for various steps of the commissioning process shall be divided among the members of the commissioning team, as described in this section.

F. The Commissioning Authority shall have responsibility for coordinating and directing each step of the commissioning process.

G. Mechanical system installation, start-up, testing, balancing, preparation of O & M manuals, and operator training are the responsibility of the Division 23 Contractors (under this contract), with coordination, observation, verification and commissioning the responsibility of this commissioning authority. The Commissioning process does not relieve Division 23 from the obligations to complete all portions of work in a satisfactory and fully operational manner.

END OF SECTION

SECTION 23 20 13
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings for:

1. Heating water piping system.
2. Glycol water piping system.
3. Equipment drains and overflows.
4. Unions, flanges and couplings.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 29 - Hangers and Supports for HVAC Piping, Ductwork and Equipment.

C. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

D. Section 23 07 19 – HVAC Piping Insulation.

E. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping.

F. Section 23 25 31 - Water Treatment for Heating Systems.

G. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

B. ASME B31.5 - Refrigeration Piping.

C. ASME B31.9 - Building Services Piping.

D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

E. ASTM B88 - Seamless Copper Water Tube.

F. ASTM D1785 - Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

G. ASTM D2241 - Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series).

H. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.

I. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite-Sewer Piping.

J. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

K. ASTM D3309 - Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems.

L. ASTM F876 - Crosslinked Polyethylene (PEX) Tubing.

M. ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot - and Cold - Water Distribution Systems.

N. AWS D1.1 - Structural Welding Code.

O. AWWA C151 - Ductile-Iron Pipe,Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use grooved mechanical couplings and fasteners only in accessible locations.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Use non-conducting dielectric connections whenever jointing dissimilar metals.

E. Provide pipe hangers and supports in accordance with Section 23 05 29.

1.5 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Include data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Welders Certificate: Include welder’s certification of compliance with ASME SEC 9.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual routing of piping.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum ten years documented experience.

C. Welders: Certify in accordance with ASME SEC 9 and AWS D1.1.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 23 05 00.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40, [0.375 inch wall for sizes 12 inch and over,] black.

1. Fittings: Malleable iron or forged steel welding type fittings.
2. Joints: Threaded or welded.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: Cast brass, or solder wrought copper.
2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
3. Press fittings:
   a. Manufacturers:
      1) Viega ProPress.
      2) Substitutions: None.
   b. Material:
      1) Tubing Standard: Copper tubing shall conform to ASTM B88.
      2) Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME, B16.22, or ASME B16.26.
      3) Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect®) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
      4) Threaded Fittings: Pipe Threads shall conform to ASME B1.20.1.
      5) Hanger Standard: Hangers and supports shall conform to MSS-SP-58.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or malleable iron.
2. Joints: Threaded, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: Cast brass, or solder wrought copper.
2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.3 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.1 EXAMINATION

A. ProPress piping system:

1. Examine the copper tubing and fittings for defects, sand holes or cracks. There shall be no defects of the tubing or fittings. Any damaged tubing or fittings shall be rejected.
2. Ensure that sealing elements are properly in place and free from damage. For Sizes 2-1/2" to 4", ensure that the stainless steel grip ring is in place.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems.

F. ProPress piping system:

1. Copper tubing shall be cut with a wheeled tubing cutter or approved copper tubing cutting tool. The tubing shall be cut square to permit proper joining with the fittings.
2. Remove scale, slag, dirt and debris from inside and outside of tubing and fittings before assembly. The tubing end shall be wiped clean and dry. The burrs on the tubing shall be reamed with a deburring or reaming tool.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install piping to ASME B31.9.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide expansion loops where shown on Drawings. Anchor pipe with U-bolt or iron bar clamps secured to building structure. Provide guides to maintain position and alignment of piping. Where space does not allow space for expansion loop, provide expansion joints.

I. Install runouts from mains and risers with swing joints of sufficient length to absorb vertical expansion or contraction of risers and horizontal expansion or contraction of mains.

J. Provide access where valves and fittings are concealed.

K. Slope piping and arrange systems to drain at low points. Provide manual drain at low points and bottom of risers.

L. Use eccentric reducers to maintain top of pipe level.

M. Use non-conducting dielectric connections whenever jointing dissimilar metals.

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

P. Install control valves. Run piping full size to valve, use concentric increasers at valves outlets and eccentric reducers at inlets.

Q. ProPress piping system:

1. Pressure Rating: Install components having a pressure rating equal to or greater than the system operating pressure.
2. Install piping free of sags, bends and kinks.
3. Change in Direction: Install fittings for changes in direction and branch connections. Where approved, changes in direction may also be made by bending of Types K and L tube.
4. Solder Joints: Solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
5. Threaded Joints: Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
6. Flared Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose.

7. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
8. Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
9. Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve. Penetrations for fire resistant rated assemblies shall maintain the rating of the assembly.

3.4 TESTING OF PIPING SYSTEMS

A. Test under hydrostatic pressure of 100 psig or 1-1/2 times normal operating pressure, whichever is greater, for a period of four hours.

B. Apply tests to all piping and equipment which a part of these systems, including tanks, pumps, and valves, except for items that might be damaged because of excessive pressures.

C. Start systems following a procedure that will remove all air.

END OF SECTION

SECTION 23 20 19

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air vents.

B. Air separators.

C. Expansion tanks.

D. Expansion tanks - diaphragm type.

E. Circuit balancing valves.

F. Test plugs.

G. Relief valves.

H. Strainers.

I. Glycol specialties.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 25 31 - Water Treatment for Heating Systems.

C. Section 23 20 13 - Hydronic Piping.

1.3 REFERENCES

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model [and dimensions].

C. Submit inspection certificates for pressure vessels from [authority having jurisdiction.]

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of glycol system for one year from date of substantial completion.

B. Visit four times during the first year to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

B. Provide one extra 10 gallon drum of propylene glycol.

PART 2 PRODUCTS

2.1 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:

1. Manufacturers:
    a. Armstrong.
    b. Bell and Gossett.
    c. Braukmann.
    d. Hoffman Specialty.
    e. Taco.
    f. Thrush/Amtrol.
    g. Substitutions: Refer to Section 23 05 00.
2. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.2 AIR SEPARATORS

A. In-line Air Separators:

1. Manufacturers:
    a. Armstrong.
    b. Bell & Gossett.
    c. Taco.
    d. Substitutions: Refer to Section 23 05 00.
2. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME SEC 8-D; for 125 psig operating pressure.

2.3 EXPANSION TANKS

A. Manufacturers:

1. Armstrong.
2. Bell and Gossett.
3. John Wood.
4. Taco.
5. Wessels.
6. Substitutions: Refer to Section 23 05 00.

B. Construction: Closed, welded steel, tested and stamped in accordance with ASME SEC 8-D; cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.

1. Pressure rating: 100 psig.
2. Size: Refer to Drawings.

C. Gage Glass Set: Brass compression stops, guard, and 3/4 inch red line glass, maximum 24 inches length, long enough to cover tank for 2 inches above bottom to 2 inches below top.

D. Quick Connect Air Inlet:

1. Compressed Air: 75 inches of 1/4 inch diameter braided reinforced air hose, air chuck, check valve, and shut-off valve on supply from control air compressor.
2. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

E. Automatic Cold Water Fill Assembly: Pressure reducing valve, [reduced pressure] double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

F. Size: Refer to drawings.

2.4 EXPANSION TANKS- DIAPHRAGM TYPE

A. Manufacturers:

1. Bell & Gossett.
2. Thrush/Amtrol.
3. Wessels.
4. Substitutions: Refer to Section 23 05 00.

B. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible [butyl] [EPDM] diaphragm sealed into tank [, and steel support stand].

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to [12] psig.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, [reduced pressure] double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

E. Size: Refer to Drawings.

2.5 CIRCUIT BALANCING VALVES

A. Manufacturers:

1. Armstrong.
2. Oventrop.
3. Nibco.
4. Tour Anderson.
5. Substitutions: Refer to Section 23 05 00.

B. General: Balancing valves with provision for connecting portable differential pressure meter. Each meter connection for pressure and temperature probes. Provide precise flow measurement, precise flow balancing, and positive shut-off with no drip seat. Solder, threaded, flanged or grooved end connections.

C. Construction: Nonferrous pressure diecast nonporous copper allow, or ductile iron conforming to ASTM Grade A535.

D. Calibration: Control flow within 2 percent of selected rating.

E. Control Mechanism: One, four, eight, twelve, or sixteen 360 degree adjustment turns with memory feature, locking feature tamper-proof setting, and digital readout.

F. Accessories:

1. Drain kit for field mounting.
2. Insulation kit - preformed rigid polyurethane insulation for complete enclosure of valve.
3. Portable meter: Carrying case containing one, 3 percent accuracy pressure gage with 0-60 feet pressure range for 500 psig maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.6 TEST PLUGS

A. 1/4 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F.
2. Nordel core for temperatures up to 350 degrees F.
3. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a. Two 2-1/2 inch diameter pressure gages.
      1) Two gage adapters with 1/8 inch probes.
      2) Scale to match system.
   b. Two 1-1/2 inch dial thermometers.
      1) Scale to match system.

2.7 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers: Watts Type 174A or 740, or equivalent by:
   a. Bell & Gossett.

b. Kunkle

c. Substitutions: Refer to Section 23 05 00.

2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, sized for application.

B. Temperature and Pressure Relief:

1. Manufacturers: Watts Type 40, or equivalent by:

a. Bell & Gossett.

b. Kunkle

c. Substitutions: Refer to Section 23 05 00.

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME SEC IV certified and labelled.

2.8 STRAINERS

A. Manufacturers:

1. Armstrong.

2. Hayward.

3. Metra-Flex.

4. Mueller.

5. Sarco.

6. Titan.

7. Watts.

8. Substitutions: Refer to Section 23 05 00.

B. Size 2 inch and Under: Threaded cast iron body for 400 psig wog or Class 250, Y pattern with 20 mesh stainless steel perforated screen.

C. Size 2 inch to 4 inch: Class 125, flanged [or grooved] iron body, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5 inch and Larger: Class 125, flanged [or grooved] iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 GLYCOL SPECIALITES

A. Mixing Tank: 55 gallon steel drum with fittings suitable for filling and hand pump for charging, rubber hose for connection of hand pump to system.

B. Storage Tank: Closed type, welded steel constructed, tested and stamped in accordance with ASME SEC 8-D; 125 psi rating; cleaned, prime coated, and supplied with steel support saddles. Construct with tappings for installation of accessories.

C. Expansion Tank: Diaphragm type with vent fitting with air separator, and automatic air vent.

D. Glycol Solution: Refer to Section 23 25 31.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. Provide valved drain and hose connection on strainer blow down connection.

E. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

F. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

G. Pipe relief valve outlet to nearest floor drain.

H. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

I. Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 31.

J. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

END OF SECTION

SECTION 23 20 20

HYDRONIC WATER FILTRATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Side Stream Filtration.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

C. Section 23 20 19 – Hydronic Specialties.

D. Section 23 25 31 - Water Treatment for Heating Systems.

1.3 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

PART 2 PRODUCTS

2.1 FULL STREAM OR SIDE STREAM FILTERS

A. Manufacturers

1) Wessels – WesFlo.

2) Substitutions: None.

B. Provide a filter system with single or multi-bag filters made of 304 polished SS. Provide with swing bolt (quick opening) closure and internal positive pressure bag hold down device. Sizes range from 2" NPT or Flng up to 6" flange connection to meet indicated flow on schedule. Filter to be constructed of 304SS filter housing rated for 150psi at 300F. Provide standard EPDM O-ring, NPT drain valve and air vent. Filter to be 25 micron polypropylene bag with options for 10 and 5 micron bag filters.

2.2 SIDE STREAM BAG FILTERS OR CARTRIDGE

1. Provide a bypass filter system – system to be ¾" or 1" and shall include filter, sight flow indicator, ball valve, balancing valve, and nipples. Filter to be constructed of 304SS filter housing (10" minimum) with brass head and to include two EPDM O-rings, brass drain valve with barb fitting and cap, filter to be a 25 micron cotton wound filter cartridge with tin core. Sight flow indicator to have a brass body and include EPDM O-rings, two tempered borosilicate glass windows, 304SS cage, TPX ball, and cork washers. Ball valve to be of brass construction. Manual balancing valve to be of brass construction with an integral air vent, memory stop, and be able to provide flow metering, blow balancing and filter cartridge isolation.
2. Provide a filter system with single or multi-bag filters for flows from 30 to 960 GPM. Casing to be made of 304 polished stainless steel. Provide with swing bolt (quick opening) closure and internal positive pressure bag hold down device. Sizes range from 2" NPT or Flng. up to 6" flange connection to meet indicated flow on schedule. Filter to be constructed of 304SS filter housing rated for 150psi at 300F. Provide standard EPDM O-ring, NPT drain valve and air vent. Filter to be 25 micron polypropylene bag with options for 10 and 5 micron bag filters.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Install as indicated on the drawings.

C. Provide 10 extra cartridges or 5 bags based on the unit provided.

D. Install shut off valves on inlet and discharge side of filters.

E. Provide a shut off valve on filter drain and pipe as indicated on the drawings.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vertical in-line pumps.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Section 23 07 16 - Equipment Insulation.

E. Section 23 20 13 - Hydronic Piping.

F. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

1.4 PERFORMANCE REQUIREMENTS

A. Pumps shall operate at specified system fluid temperatures without vapor binding and cavitation.

B. Pumps shall be non-overloading in parallel or individual operation.

C. Pumps shall operate within 25 percent of midpoint of published maximum efficiency curve.

D. Pumps shall operate from zero flow to 50% above design flow without exceeding rated full load nameplate horsepower.

1.5 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories as suitable for the purpose specified and indicated.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

B. Provide 2 sets of cartridges or bags for each side-stream filter.

PART 2 PRODUCTS

2.1 VERTICAL IN-LINE PUMPS

A. Manufacturers:

1. Bell & Gossett Series 80.
2. Other acceptable manufacturers offering equivalent products.
    a. Armstrong.
    b. Peerless
    c. Taco
    d. Substitutions: Under provisions of Section 23 05 00.

B. Type: Vertical, single stage, close coupled, radially split casing, for in-line mounting, for 175 psig working pressure.

C. Casing: Cast steel, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

D. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

E. Shaft: Carbon steel with stainless steel impeller cap screw or nut [and bronze sleeve].

F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.

G. Performance: Refer to Pump Schedule on Drawings.

H. Electrical Characteristics:

1. Refer to Pump Schedule on Drawings.
2. Motor: 1750 rpm unless specified otherwise; refer to Section 23 05 13.
3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Refer to Section 23 05 48.

D. Provide line sized shut-off valve on pump suction, and line sized check valve and balancing valve on pump discharge.

E. Lubricate pumps before start-up.

END OF SECTION

SECTION 23 25 31

WATER TREATMENT FOR HEATING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

B. Water treatment system for:

1. Closed hot water heating system.

C. Chemical test kits.

D. Glycol protection.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

C. Section 23 20 19 - Hydronic Piping Specialties.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

C. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 23 05 00.

B. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

C. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

D. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State or Municipality of standard for addition of non-potable chemicals to building systems and for discharge to public sewers.

B. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories as suitable for the purpose specified and indicated.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.

B. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS-WATER TREATMENT SYSTEMS

A. Fremont Industries.

B. Jay-Tec.

C. Nalco.

D. U. S. Water Services.

E. Substitutions: Under provisions of Section 23 05 00.

2.2 CHEMICAL TEST KIT

A. Furnish basic water test equipment, spare reagents for maintaining control of program standards in the condenser water, chilled water, heating water, and steam systems.

1. Test kits shall include the following:

a. Reagents and apparatus for determination of inhibitor level.

b. Reagents and apparatus for determination of pH, "P" and "M" alkalinity and chlorides.

c. Apparatus for determination of microbiological colony population and biocide effectiveness.

d. A hand held conductivity meter shall also be included.

2.3 MANUFACTURERS - GLYCOL PROTECTION

A. Dow Chemical.

B. Fremont Industries.

C. Noble Company.

D. Union Carbide.

E. Substitutions: Under provisions of Section 15010.

2.4 GLYCOL PROTECTION

A. Equal to Dow Dowfrost HD.

B. Industrially inhibited propylene glycol (phosphate-based) fluid.

C. Dyed to facilitate leak detection. Must be easily analyzed for glycol concentration and inhibitor level.

D. Fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all system metals).

E. The reserve alkalinity of the fluid shall be at least 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide all piping required for system operation.

3.3 CLEANING OF PIPING SYSTEMS

A. Concentration:

1. As recommended by manufacturer.
2. One pound of trisodium phosphate per 100 gallons of water for hot systems and one pound of trisodium phosphate per 50 gallons of water for cold systems.
3. Fill steam boilers only with cleaner and water.

B. Hot Water Heating Systems:

1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier.

D. Flush glycol-filled closed systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.4 CLOSED SYSTEM

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

D. Provide feeders with shutoff valves and bypass.

E. Provide sampling connection in the circulating water line including a 1/4 inch ball valve.

F. Provide chemical treatment to protect closed systems from corrosion.

3.5 CHEMICALS

A. After piping systems have been cleaned, treat systems with necessary chemicals to protect them from corrosion damage. Notify Owner in writing that this work has been completed and tested, with a copy to Engineer.

B. Chemicals shall be acceptable to FDA, City and State PCA and shall not contain any chromates. Steam will be used for humidification.

C. Water Treatment Chemicals - Closed System:

1. Provide one year's supply of the recommended formula for scale and corrosion protection for the closed recirculating system.

2. Formulation shall not contain any ingredients which are harmful to system materials of construction.

3.6 GLYCOL PROTECTION

A. Provide sufficient quantity of anti-freeze fluid into the piping systems, where required, to provide a 50 percent glycol/50 percent water solution.

B. Use water with low levels (less than 50 ppm) of chloride, sulfate and hard water ions (Ca^{++}, Mg^{++}) for filling systems that will contain the water/glycol fluid solution.

END OF SECTION

SECTION 23 31 13

METAL AND NON-METAL DUCTWORK, CASING AND PLENUMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Casing and plenums.

D. Duct Cleaning.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 29 - Hangers and Supports for HVAC Piping, Ductwork and Equipment: Sleeves.

C. Section 23 05 93- Testing, Adjusting and Balancing.

D. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

E. Section 23 33 13 - Ductwork Accessories.

F. Section 23 37 13 - Air Inlets and Outlets.

1.3 REFERENCES

A. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.

B. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

C. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

D. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

E. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

F. SMACNA - HVAC Air Duct Leakage Test Manual.

G. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

H. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Indicate construction methods including; duct materials, gages, reinforcing and sealing, fittings, hangers and supports.

C. Fabrication Drawings: Actual duct fabrication drawings, indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work. Indicate any deviations from applicable SMACNA Standards. Issue copies to related trades for coordination. After all coordination is complete and acceptable to all affected trades, submit to Engineer.

D. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible, unless more stringent requirements are noted herein.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum ten years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Perform Work in accordance with NFPA 90A and NFPA 90B standards.

B. Perform Work in accordance with International Mechanical Code with Minnesota Amendments.

C. Perform Work in accordance with Minnesota Energy Code.

D. Perform Work in accordance with State and Local Code requirements.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

B. Steel Ducts: ASTM A366.

C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

D. Insulated Flexible Ducts:

1. Manufacturers:

   a. Flex-Aire.

   b. Flexmaster.

   c. Norflex.

d. Sheet Metal Connectors.

e. Thermaflex.

f. Wiremold.

g. Substitutions: Refer to Section 15010.

2. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.

4. Maximum Velocity: 4000 fpm.

5. Temperature Range: -10 degrees F to 160 degrees F.

E. Stainless Steel Ducts: ASTM A167, Type 304.

F. Fasteners: Rivets, bolts, or sheet metal screws.

G. Sealant:

1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

H. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. [Comply with requirements of International Mechanical Code with Minnesota Amendments, when more stringent than those contained herein].

B. When operating pressures are not indicated on the drawings, construct the entire duct system for the fan outlet pressure.

C. Duct sealing requirements:

1. SMACNA Seal Class “A”;

a. Entire duct system where fan is rated at (+/-) 2 inches water column or greater external static pressure, unless noted otherwise.

b. Variable air volume (VAV) duct system from fan discharge to inlet of VAV box.

c. Duct system with booster coils, from fan discharge to inlet of booster coil.

d. Duct system enclosed in shafts or above inaccessible ceilings where fan is rated at (+/-) 1 inch water column or greater external static pressure.

2. SMACNA Seal Class “B”;

a. Entire duct system where fan is rated from (+/-) 1 inch to (+/-) 2 inches water column external static pressure, unless noted otherwise.

b. Duct system enclosed in shafts or above inaccessible ceilings where fan is rated less than (+/-) 1 water column external static pressure.

3. SMACNA Seal Class “C”;

a. Entire duct system where fan is rated at less than (+/-) 1 inch water column external static pressure, except gravity transfer ducts, and exhaust ducts discharging into ceiling plenum.

D. Portions of duct system with width or height dimension greater than 18 inches which are required to be constructed to SMACNA Seal Class “A” or “B”, shall utilize transverse duct connection system.

E. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

H. Rigidly construct ducts with joints mechanically tight, braced and stiffened to not breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

I. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

K. Sheet metal duct liner; [Provide solid 22 gage galvanized steel liner over interior duct insulation.][Provide perforated 22 gage galvanized steel liner over interior duct insulation. Perforations to be 3/32 inch diameter on 3/16 to 1/4 inch centers.][Provide perforated 22 gage galvanized steel liner of interior duct insulation. Perforations to be 3/32 inch diameter on 3/16 to 1/4 inch centers. Install 6 mil mylar or polyethylene sheet between insulation and liner.][Refer to Section 23 07 13 for insulation requirements.]

2.3 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, International Mechanical Code with Minnesota Amendments, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Flat Oval Ducts:

1. Manufacturers:

   a. Semco.

   b. Sheet Metal Connectors.

   c. United McGill.

   d. Substitutions: Refer to Section 23 05 00.

2. Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gages heavier metal than duct.

C. Single Wall Spiral Round Ducts:

1. Manufacturers:

   a. Semco.

   b. Sheet Metal Connectors.

c. United McGill

d. Substitutions: Refer to section 23 05 00

2. Machine made from round 4 ply spiral lockseam duct.

D. Transverse Duct Connection System:

1. Manufacturers:

a. Ductmate.

b. EZ Flange.

c. TDC.

d. Ward.

e. Substitutions: Refer to Section 23 05 00.

2. SMACNA "F" rated or SMACNA "J" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, bolts, cleats, and corner clips.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, unless more stringent requirements are noted herein. Comply with requirements of International Mechanical Code with Minnesota Amendments, when more stringent than those contained herein.

C. Install duct as high as possible to maintain headroom.

D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

E. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Install round branch duct to rectangular mains with conical, bellmouth or flared spin-in fittings.

H. Make tee connections with a radius tap-in unless noted otherwise.

I. Lap metal ducts in direction of air flow. Hammer down edges of slips and drives with duct mastic in corners to leave smooth duct interior and a tight fitting corner.

J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

K. Use double nuts and lock washers on threaded rod supports.

L. Pack space between duct and wall, ceiling or floor with glasswool. Fill with 1/2 inch sealing compound. In rated walls, ceilings or floors, use fire rated sealing compound.

M. Coordinate location of duct access panels with wall or ceiling access doors.

N. Duct hangers shall not attach to bottom chord of steel joist or metal roof decking. Attach to top chord of steel joist.

O. Provide adequate access into ductwork for cleaning purposes.

P. Elbows and angles for spiral ductwork shall be five piece standing seam construction, 18 gauge with 1 full sweep (C.L. Radius = 1.5 x Diameter) unless physical space is not available.

Q. Provide short radius 90 degree elbows with turning vanes as indicated on the drawings. Short radius elbow with turning banes shall be constructed in accordance to SMACNA 1995 standards, appendices A-41 and A-43. Construct elbow with six (6) inch inside radius for ducts up to 48 inches wide and twelve (12) inches for ducts 48 inches and over. No exceptions unless approved by the engineer.

3.2 FLEXIBLE DUCTS:

A. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct.

B. Connect diffusers to low pressure ducts directly or with 3 feet maximum length of flexible duct held in place with strap or clamp.

C. Connect flexible ducts to metal ducts with draw bands and additional sealing to provide air tight joint.

D. Support flexible duct properly to avoid sags and crimping.

E. Do not use flexible duct to change direction.

3.3 PROTECTION

A. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.4 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION

SECTION 23 33 13
DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers.

C. Combination fire and smoke dampers.

D. Duct access doors.

E. Duct test holes.

F. Fire dampers.

G. Flexible duct connections.

H. Volume control dampers.

I. Pressure gages and Pressure gage taps.

J. Thermometers and thermometer wells.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 23 31 13 – Metal and Non-Metal Ductwork, Casings and Plenums.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. NFPA 70 - National Electrical Code.

C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

D. UL 33 - Heat Responsive Links for Fire-Protection Service.

E. UL 555 - Fire Dampers and Ceiling Dampers.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

E. Product Data: Provide manufacturers data and list which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of components and instrumentation.

C. Operation and Maintenance Data: Include instructions for calibrating instruments.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., or similar testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.9 MAINTENANCE PRODUCTS

A. Supply two bottles of red gage oil for static pressure gages.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. No manufactured turning vanes in square elbows are allowed. See Section 23 31 13 for short radius elbow with turning vanes. No exceptions unless approved by Engineer.

B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.2 BACKDRAFT DAMPERS.

A. Manufacturers:

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Louvers and Dampers.
5. Nailor.
6. Pottorff.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Gravity Backdraft Dampers, Furnished with Air Moving Equipment: Air moving equipment manufacturers standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized steel, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Nailor.
5. Pottorff.
6. Prefco.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with NFPA 90A, UL 555 (latest edition), UL 555S (latest edition).

C. Rated for 1-1/2 hour Leakage Class II or 3 hour Leakage Class I protection. Refer to drawings for type based on partition.

D. Rated for 2.5 inches WG pressure and 2000 fpm velocities or 4.0 inches WG pressure and 4000 fpm velocities. Refer to drawings for type based on system.

E. Provide factory sleeve and collar for each damper, either break-away or rigid, based on system.

F. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and actuator shaft.

G. Actuators: UL listed and labeled spring return [pneumatic type suitable for operation on 0-20 psig instrument air.] [electric type suitable for 120 volts, single phase, 60 Hz.] [electric type suitable for 24 volts, DC.] [Provide end switches to indicate damper position.] Locate damper operator on [interior] [exterior] of duct and link to damper operating shaft. Provide for testing or resetting [at damper] [from remote location].

H. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.

I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices [to ensure positive closure for units mounted horizontally].

2.4 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 inch thick insulation with sheet metal cover.

1. Less Than 12 inches Square: Secure with sash locks.
2. Up to 18 inches Square: Provide two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.5 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FIRE DAMPERS

A. Manufacturers:

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Nailor.
5. Pottorff.
6. Prefco.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with NFPA 90A and UL 555 (latest edition), and as indicated.

C. Free area 90% minimum.

D. Rated for 1-1/2 hour or 3 hour protection depending on partition type.

E. Provide factory sleeve and collar for each damper, either break-away or rigid, based on system.

F. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side, and one layer on bottom side for round flaps, with locking clip.

G. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

H. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations and closure under air flow conditions. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

I. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

J. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Ventfabrics.
2. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3 inches wide, 24 gage thick, galvanized steel.

D. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.087 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.8 SMOKE DAMPERS

A. Manufacturers:

1. Air Balance
2. Cesco.
3. Greenheck.
4. Nailor.
5. Pottorff.
6. Prefco.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with NFPA 90A, UL 555 (latest edition), UL 555S (latest edition), Leakage Class II up to 2.5 inches w.g. or Leakage Class I for 2.5 inches to 4 inches w.g.

C. Rated for 2.5 inches WG pressure and 2000 fpm velocities or 4.0 inches WG pressure and 4000 fpm velocities. Refer to drawings for type based on system.

D. Provide factory sleeve and collar for each damper, either break-away or rigid, based on system.

E. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and actuator shaft.

F. Actuators: UL listed and labeled spring return electric type suitable for 24 volts, DC. Provide end switches to indicate damper position. Locate damper operator on exterior of duct and link to damper operating shaft. Provide for testing or resetting at damper.

2.9 VOLUME CONTROL DAMPERS.

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

4. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 13 for duct construction and pressure class.

B. Install control dampers furnished by Controls Contractor.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, humidifiers, duct mounted smoke detectors, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

E. Provide duct test holes where indicated and required for testing and balancing purposes.

F. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through rated partitions. Install with required perimeter mounting angles, sleeves, breakaway or rigid duct connections based on system type, corrosion resistant springs, bearings, bushings and hinges.

G. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

H. Demonstrate re-setting of fire dampers to Owner's representative.

I. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.

J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

K. Use splitter dampers only where indicated.

L. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 37 13

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grilles, registers and diffusers.

B. Louvers.

1.2 RELATED SECTIONS

A. Section 09 91 23 – Interior Painting: Painting of ductwork visible behind outlets and inlets.

B. Section 23 05 00 - Common Work Results for HVAC Equipment.

C. Section 23 31 13 – Metal and Non-Metal Ductwork, Casings and Plenums.

D. Section 23 33 13 - Ductwork Accessories.

1.3 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ARI 650 - Air Outlets and Inlets.

D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

F. NFPA 70 - National Electrical Code.

G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

PART 2 PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS

A. Manufacturers:

1. Titus.
2. Krueger.
3. MetalAire.
4. Nailor.
5. Price.
6. Anemostat.
7. Tuttle & Bailey.
8. Substitutions: Refer to Section 23 05 00.

B. Refer to Schedule on drawings for type, frame, fabrication, finish and accessories.

2.2 LOUVERS

A. Manufacturers:

1. American Warming and Ventilating.
2. Arrow United.
3. Cesco.
4. Greenheck.
5. Louvers and Dampers.
6. Ruskin.
7. Substitutions: Refer to Section 23 05 00.

B. Type: 6 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

C. Fabrication: 16 gage thick galvanized steel, welded assembly, with factory baked enamel finish, color to be selected.

D. Mounting: Furnish with exterior flange for installation.

PART 3 EXECUTION

3.1 GRILLES, REGISTERS AND DIFFUSERS

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Rigidly fasten grilles, registers and diffusers to duct.

D. Install grilles, registers and diffusers to ductwork with air tight connection.

E. Adjust directional tabs in square diffusers and in linear diffusers to provide proper air distribution pattern.

F. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

G. Paint ductwork visible behind air outlets and inlets matte black.

3.2 LOUVERS

A. Provide collars and connections to louvers and blank off unused portions.

B. Construct plenums and blank-off panels to form airtight seal with louver edges. Construct plenums watertight to drain moisture back outside louver.

C. Insulate plenum with 2 inch thick rigid fiberglass with vapor barrier.

D. Provide drains when plenum is lower than bottom edge of louver. Run to floor drain.

E. Install in accordance with manufacturer's instructions.

F. Install louvers in exterior walls, complete with lintels, mullions and sills. Caulk perimeter of each section with silicone sealant to make weather tight.

G. Provide collars and connections to louvers and blank off unused portions.

H. Construct plenums and blank-off panels to form airtight seal with louver edges. Construct plenums watertight to drain moisture back outside louver.

I. Insulate plenum with 2 inch thick rigid fiberglass with vapor barrier.

J. Provide drains when plenum is lower than bottom edge of louver. Run to floor drain.

END OF SECTION

SECTION 23 52 38

CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensing High Efficiency Boilers.

B. Packaged Control System.

C. Condensate neutralizer/drainer.

1.2 RELATED SECTIONS

A. Section 23 20 19 - Hydronic Specialties

B. Section 25 95 00 - Sequence of Operation.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ASME SEC 4 - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.

D. ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

E. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NFPA 54 - National Fuel Gas Code.

H. NFPA 70 - National Electrical Code.

I. UL - Gas and Oil Equipment Directory.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals: Procedures for submittals.

B. Shop Drawings: Indicate general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

D. Submit manufacturer's installation instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Submittals for project closeout.

B. Test Reports: Indicate specified performance and efficiency is met or exceeded. Provide combustion test that includes boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.

C. Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in installing and servicing the products of this section with minimum five years documented experience approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

A. Conform to ASME SEC 4, SEC 8D, AGA Z21.13 Code, and UL 726 for construction of boilers.

B. Units: UL labeled.

C. Conform to applicable NFPA 70 code for internal wiring of factory wired equipment.

D. Conform to State of Minnesota requirements.

E. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.9 WARRANTY

A. Section 23 05 00 - Warranties.

B. Provide a minimum of a five (5) year warranty for flue gas corrosion compromising the pressure vessel and exhaust assembly.

C. Provide a one (1) year parts and labor warranty entire package. The warranty period is to begin at the final date, as determined and agreed upon by the engineer and contractor, of Substantial Completion.

1.10 MAINTENANCE/BOILER SYSTEM CONTROL PROGRAMMING SERVICE

A. Provide a service and maintenance program of the boiler system for the duration of the warranty period. The program is to consist of the five (5) following on-site service procedures:

1. Initial Start-up and Owner training: Late Summer/early Autumn.
2. Mild heating weather control & efficiency monitoring/check-up: Late Autumn.
3. Cold weather control & efficiency monitoring/check-up: Winter (Outdoor temperature must be below 0F).
4. Mild heating weather control & efficiency monitoring/check-up: Late Winter/Spring.
5. Fall start-up/control & efficiency monitoring/warranty close-out: Autumn of second season.

B. The intent of each service call is to set and obtain optimum thermal efficiency of the boiler system as the weather changes without compromising heating comfort within the facility. Each procedure is to consist of scheduling a service technician to be on-site for two (2) hours, provide monitoring of the current boiler reset as it relates to the current weather conditions, obtaining trending data (by working with and coordinating with the Owner's building automation system contractor) of how the boiler system has been responding to the reset schedule sequencing/setpoints along with interviewing the building operator regarding overall heating comfort in the building. The result of each service call is to provide a report demonstrating the controls are operating as intended while meeting building occupant comfort over a trended amount of time from previous site visit.

C. Include an additional follow-up site visit in addition to the on-site service procedures by a service technician with two (2) hours of on-site time to make adjustments to setpoints and programming necessary. A total of a possible five (5) follow-up site visits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Boilers:

1. Hydrotherm 'KN' Series.
2. Lochinvar 'Crest' Series.
3. Aerco 'Benchmark' Series.
4. Cleaver-Brooks 'ClearFire' Series.
5. Substitutions: None.

B. Integrated Boiler Management System:

1. Hydrotherm 'HeatNet' controller.
2. Lochinvar 'SmartTouch' controller.
3. Aerco 'C-More' unit controller'.
4. Cleaver-Brooks 'Falcon' controller.
5. Approved third party boiler integrator: Modsync, Siemens,
6. Substitutions: None.

2.2 GENERAL DESCRIPTION

A. Modulating, forced draft, condensing type; complete with boiler fittings and automatic controls. The boiler (with all wiring) shall be completely factory assembled as a self contained unit. Boiler design and construction shall be in accordance with ASME Section IV for hot water heating boilers with a maximum water working pressure of 30 psig. Boiler shall also comply with CSD-1 Code requirements.

2.3 BOILER DESIGN

A. The boiler shall have the ability to operate with a variable flow through the boiler. The boiler is to be designed for a minimum of 5:1 continuous turn down with constant CO2 over the turndown range. The boiler is to operate with natural gas and have a CSA International certified input rating as noted on the drawings, and a thermal efficiency rating up to 99% at minimum input. The boiler is to use a proven pilot interrupted spark ignition system. The boiler is to use a UL approved flame safeguard ignition control system using UV detection flame sensing. The design is to provide for silent burner ignition and operation. Adequate openings are to be provided to allow access to the water side of the boiler.

B. The condensing section of the exhaust pipes are to be constructed of SAF 2205 Deflex stainless steel. The vessel shell shall be SA-53B ERW pipe or SA-516 Grade 70 plate. The heads shall be SA-516 Grade 70 plate. The pressure vessel is to be fully insulated with 2" of high temperature insulation.

C. Provide a condensate drainer and neutralizer kit with capacity and ability to address the boiler system condensate loading. Provide the kit complete and piped to a floor drain. The drainer is to be provided and installed in conformance with the boiler manufacturers recommendations.

2.4 BOILER SIZE AND RATINGS

A. Refer to schedule on drawings for capacities.

B. The boiler shall have a low fire efficiency of 94% at 100 degree F. return water temperature and 100 degree F. flue gas temperature.

C. The boiler shall have a high fire efficiency of 84% at 160 degree F. return water temperature and 250 degree F. flue gas temperature.

2.5 BOILER FLUE VENTING

A. This contractor is to provide all necessary materials and labor for a complete installation. Exhaust venting shall be constructed of AL294C piping and installed in conformance with the manufacturers recommendations based on the conditions of the site. Refer to the drawings for pipe routing.

2.6 COMBUSTION AIR DUCTING

A. This contractor is to provide all necessary materials and labor. Schedule 80 PVC Pipe. Provide PVC fittings with solvent welded joints. Install per ASTM D2321 and the boiler manufacturers recommendations based on conditions of the site. Provide field-installed external insulation on entire combustion air ducting, including the combustion chamber box on the boiler. Refer to the drawings.

2.7 BOILER FITTINGS

A. A temperature and pressure relief valve is to be provided with each boiler.

B. A temperature and pressure gauge shall pre provided with each boiler.

2.8 COMBUSTION EQUIPMENT

A. Provide boiler with a UL approved flame safeguard. The controller shall provide a 30 second pre-purge and post-purge. The controller shall maintain a running history of operating hours, number of cycles, and the most recent six flame failures. This controller shall have the capability to be connected to an AZL Display Module, which will retrieve that information.

B. Each boiler shall be equipped for fully modulating operation. Turn down shall be 5:1.

C. The furnace location shall be such that all furnace components are located within water-backed areas. Boiler safety controls shall be:

1. Operating temperature controller for automatic start and stop of the pulse combustor.
2. High limit temperature controller (manual reset).
3. One low water cutoff probe in boiler shell (manual reset).
4. One auxiliary low water cutoff (manual reset).
5. Air safety switch to prevent operation until sufficient prepurge air is assured.
6. Infrared scanner to prove combustion.

D. All controls are to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls. All controls shall be mounted and wired according to A.G.A requirements.

E. Provide single point power connection.

F. Refer to schedule on drawings for electrical requirements.

2.9 CONTROL SYSTEM

A. The boiler control system is to be provided by the boiler equipment manufacturer/supplier and be independent from the building automation system. Refer to Part 2.1 (of this section) for manufacturers.

B. Provide a completely integrated independent controller to control and manage the operation and input of the multiple boiler plant.

C. The controller is to be BACnet compatible and factory-wired to a terminal strip to allow field-connection to a building automation system.

D. The system shall be comprised of a microprocessor based control, utilizing a 4 to 20 mA signal for modulation of header temperature and sequential firing.

E. The controller shall have the ability to vary each individual modulate input throughout its full firing rage, to maximize the condensing capability of the module and the entire plant without header temperature swings.

F. The controller shall be PID type for temperature control with frequency response.

G. The control shall provide contact closure for automatic adjustable heat start circuit for plant activation and have contact closure for auxiliary equipment such as pumps and auxiliary loops.

H. The control will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature outlet to +/-2 degrees F. Maximum efficiency shall be achieved at minimum firing input.

I. Reset ratio shall be fully field adjustable. The controller shall have LCD display for monitoring of all sensors and percent of modulation on one screen. Real time and date. Controller will automatically balance operating time.

J. Connection between the control system and individual units shall be wired to internal terminal strips for easy installation.

K. Controller is to be capable of controlling a minimum of six (6) boilers. The controller shall modulate the boiler burners to maintain proper loop temperature. Refer to sequence of operation, Part 3 of this section.

L. Control system shall contain the following:

1. CPU Board.
2. Hand-Off-Auto Relay Output Board with LED indicators.
3. Auto/Manual Analog Output Board.
4. NEMA 1 enclosure.
5. Provide the unit complete with an BACnet interface card to allow the building automation system to monitor the unit.
6. Electrical power supply connection.
7. Operator Control Panel with operator inface keyboard/keypads.

2.10 CONDENSATE NEUTRALIZER/DRAINER

A. Provide one (1) central common condensate drainer/neutralization kit with drain controls.

B. Condensate drainer to be constructed entirely of polypropylene. The basin is to have a removable lid to allow neutralization media to be added/maintained. Unit is to have a basin/baffels to hold water, complete with float mechanism and ½" cold water connection in order to maintain a trap seal utilizing make-up water as necessary. Basin to be similar/equal to an AXIOM Model NT25 and modified with a chamber to hold and maintain a water level as a trap. Provide all piping materials and labor from each boiler to the neutralizer and extend to a floor drain. Provide two (2) complete fills of neutralization media equal to Axiom's '*Liphter*' media.

C. Unit to be installed in an accessible location to allow neutralization media to be maintained and added.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Install boiler on concrete housekeeping pad, sized minimum 4 inches larger than boiler base. Elevate the boiler unit(s) to allow adequate sloping of condensate drainage by gravity.

D. Provide connection of natural gas service in accordance with NFPA 54.

E. Provide piping connections and accessories.

F. Pipe relief valves to nearest floor drain.

G. Install condensate drainer. Pipe condensate drains from boiler to condensate drainer neutralizing tank and from condensate drainer to nearest floor drain. Provide a valved cold water supply line and connect to condensate drainer.

H. Provide all necessary wiring between boiler control panel, temperature sensors, boiler control units and each boiler circulation pump to obtain a complete and functioning system. All wiring to be installed in EMT conduit.

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide a field representative for unit/system start-up, training operator and all necessary programming and programming revisions necessary to 'tune' and adjust boiler sequencing.

3.3 BOILER SYSTEM SEQUENCE OF OPERATION

A. Application:

1. Condensing Hot Water Boilers.
2. Hot water boiler circulation pumps.

B. Provide a package control system which will control the hot water boilers. The control system is control and obtain modulation, turn-down, and condensing utilizing an outdoor air master reset schedule. The reset schedule is compare the outdoor temperature to reset the main supply water temperature.

C. Heating/Winter Mode:

1. The boiler control is to be 'enabled'.
2. The heating controller is to be manually switched on/off by the Building Operator.
3. The outdoor air temperature is to be monitored and compared to the heating water supply temperature. Provide a reset schedule program which will increase the supply water temperature as the outdoor temperature decreases in temperature. The reverse sequence is to apply as the outdoor air temperature becomes warmer, the supply water temperature is to be decreased down to 130F.
4. The controller is to individually control each boiler module and its respective boiler circulation pump (pumps are to be on/off) in order to obtain turn-down and utilize the condensing process in order to optimize thermal efficiency of the boiler system. The controller is to control each module turn-down ratio and stage/rotate the firing of the boiler modules, along with starting/stopping its respective circ pump to obtain both efficiency/condensing of the boilers while maintaining a reset supply water temperature.

D. Summer Mode: Boilers and controls are to be 'disabled' (off) and locked-out.

E. Miscellaneous:

1. Provide input point for outside air temperature signal from Building Management System.
2. Provide general alarm to Building Automation System.
3. Boiler controller is to be BACnet compatible and factory-wired to a terminal strip to allow field-connection by the BAS contractor. Provide a BACnet card/gateway, integral with the controller to allow the system to interface with a building automation system.

END OF SECTION

SECTION 23 74 13

PACKAGED, OUTDOOR ROOF TOP UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged roof top unit.

B. Roof mounting curb and base.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

1.3 REFERENCES

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

G. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

H. ARI 340/360 - Standard for Commercial and Industrial Unitary Air Conditioning & Heat Pump Equipment.

I. ARI 610 - Central System Humidifiers.

J. NEMA MG1 - Motors and Generators.

K. NFPA 70 - National Electrical Code.

L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

M. UL 900 - Standard for Air Filter Units.

N. UL - Fire Resistance Directory.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals.

B. Product Data:

1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.

4. Sound Power Level Data: Fan outlet, air handler inlet and outlet openings, and casing radiation at rated capacity.

5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Shop Drawings: Indicate assembly, unit dimensions and lifting lug locations, weight loading and center of gravity, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

D. Manufacturer's Instructions: Include installation instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Project Closeout.

B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, coil removal and replacement, spare parts lists, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Manufacturer shall operate each system at the factory before shipment to insure proper operation and balance.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., E.T.L. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Accept products on site in factory-fabricated protective containers [shrink wrapped form], with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.10 EXTRA MATERIALS

A. Section 23 05 00 - Project Closeout.

B. Supply one set of filters for each unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Carrier

B. Aaon

C. Trane

D. York

E. Substitutions: Refer to Section 23 05 00.

2.2 GENERAL DESCRIPTION

A. Configuration: Refer to drawings for specific requirements.

1. Outside Air Intake section
2. Economizer section
3. Supply fan and Discharge section
4. Cooling coil section
5. Heating Section
6. Power exhaust section
7. Filter section
8. Air Cooled Condenser section.
9. Spacer/access sections

B. Performance Base: Sea level conditions.

C. Fabrication: Conform to AMCA 99 and ARI 430.

D. Performance: Refer to Schedule on Drawings.

2.3 CABINET

A. Construction: Heavy gage galvanized steel with acrylic lacquer finish, stainless steel fasteners, and shall have vinyl coated fan guards. The cabinet shall be thermally insulated with 1" thick, 11/2 lb. Density glass fiber insulation.

B. Finish: Manufacturer's standard finish

C. Cabinet Access Panels: Compressor/controls/heating area access panels, blower access panel and air filter/economizer access panel hinged with tool-less access handles, gaskets on all edges for tight seal, filter and blower access panels have steel panel inner liner with insulation sandwiched in-between.

D. Roof Mounting Curb: Furnish and install a steel roof mounting frame for bottom discharge and return air duct connection. It shall mate to bottom perimeter of the equipment. When flashed into the roof it shall make a unit mounting curb and provide a weatherproof duct connection and entry into the conditioned area.

2.4 FANS AND MOTORS

A. Supply Fan: Centrifugal supply air blower shall have ball bearings and adjustable belt drive. Blower assembly shall slide out of unit for servicing. Blower wheel shall be statically and dynamically balanced. Refer to schedule on drawings.

B. Supply Fan Motor: Refer to schedule on drawings.

C. Condenser Fan: Direct drive propeller type condenser fans shall discharge vertically. Refer to schedule on drawings.

D. Condenser Fan Motor: Fan shall have ball bearings and be permanently lubricated. Refer to schedule on drawings.

E. Power Exhaust Fans: Shall be available for all models with economizer. Fans shall exhaust air through gravity exhaust dampers.

2.5 COILS

A. Air Coils: The evaporator and condenser coils shall be non-ferrous construction with aluminum fins mechanically bonded to durable copper tubes. Evaporator coil condensate drain shall be extended outside of the cabinet. Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

B. Coil Performance: Refer to schedule on Drawings.

2.6 FILTERS

A. Filter Media: Disposable 2 inch thick pleated, MERV 8.

2.7 ECONOMIZER

A. Economizer section: Furnish and install economizer complete with return air dampers, outside air dampers and controls. The economizer section shall provide for the introduction of outdoor air for minimum ventilation and free cooling. Damper actuator shall be opposing gear driven with a fully modulating design.

2.8 DAMPERS

A. Outside Air Dampers: Dampers shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Dampers shall be designed to operate from 0-100%. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" WG air pressure differential across the damper. Damper motor shall be spring return to insure closing of outdoor air damper during periods of unit shut down or power failure.

B. Return Air Dampers: Dampers shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" WG air pressure differential across the damper

C. Gravity Relief Dampers: Pressure operated dampers made of extruded aluminum shall prevent blow-back and outdoor air infiltration during off cycle.

2.9 GAS FIRED HEATER

A. Indirect Gas Fired Heater Type: Unit shall heat using natural gas fuel with a minimum two stages of capacity. Unit shall be provided with a gas heating furnace consisting of an aluminized steel tubular heat exchanger, and induced draft blower and an electric pressure switch to lockout the gas valve until the combustion chamber is purged and combustion air flow is established. Unit shall be provided with a gas ignition system consisting of an electronic ignitor to a pilot system, which will be continuous when the heater is operating, but will shut off the electronic ignition system which will de-energize upon flame detection]. Unit shall have gas supply piping entrances in the unit base for through the curb gas piping. Refer to schedule on drawings

2.10 COMPRESSOR

A. Multiple compressors shall be resiliently mounted, have overload protection and crankcase heaters.

B. Provide step capacity control by cycling compressors.

2.11 AIR COOLED CONDENSER

A. Direct drive propeller type condenser fans shall discharge vertically. Fan motor shall have ball bearings and be permanently lubricated and inherently protected. Fans shall have a safety guard. The refrigeration system shall have discharge, suction and liquid line gauges, high pressure switches, low pressure switches, dryers, a freezestat and full refrigerant charge. Refer to schedule on drawings.

B. Provide refrigerant pressure switches to cycle condenser fans.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with Manufacturer's instructions.

B. Install in accordance with ARI 435.

C. Make connections to coils with unions or flanges.

D. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil.

E. Insulate coil headers located outside air flow as specified for piping. Refer to Section 23 07 19.

SECTION 23 82 36

FINNED TUBE RADIATION HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Baseboard radiation.

B. Finned tube radiation.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. Section 23 20 13 - Hydronic Piping.

D. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals: Procedures for submittals.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
3. Indicate mechanical and electrical service locations and requirements.,

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Project Closeout.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 WARRANTY

A. Section 23 05 00 - Warranties.

1.9 EXTRA MATERIALS

A. Section 23 05 00 - Project Closeout.

PART 2 PRODUCTS

2.1 FINNED TUBE RADIATION

A. Manufacturer:

1. Sterling.
2. Sigma.
3. Rittling.
4. Vulcan.
5. Substitutions: Refer to Section 23 05 00.

B. Hydronic Heating Elements: Seamless copper tubing, mechanically expanded into evenly spaced aluminum fins, suitable for soldered fittings.

C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

D. Enclosures: 14 gage stainless steel. Enclosure style, height and mounting height, as indicated in Schedule on Drawings. Support rigidly, on wall with full backplate or floor mounted brackets at least 3 feet on center maximum. Provide end trim, corners, end enclosures, and column enclosures. Provide air seal for field installation on all backplates.

E. Finish: Factory applied baked enamel finish; color selected by Architect from standard color chart.

F. Damper: Provide knob-operated internal damper at enclosure air outlet.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, with tamperproof fasteners, 6 x 7 inch minimum size, integral with cabinet.

H. Heating Capacity: As scheduled, at 65 degrees F air temperature and 180 degrees F average water temperature.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install wall angles where units butt against walls.

E. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. Provide with vent, if not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit heaters.

B. Cabinet unit heaters.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. Section 23 20 13 - Hydronic Piping.

D. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals: Procedures for submittals.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
3. Indicate mechanical and electrical service locations and requirements.,

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Project Closeout.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 WARRANTY

A. Section 23 05 00 - Warranties.

1.9 EXTRA MATERIALS

A. Section 23 05 00 - Project Closeout.

PART 2 PRODUCTS

2.1 UNIT HEATERS

A. Manufacturer:

1. Airtherm.
2. McQuay.
3. Modine.
4. Reznor.
5. Rittling.
6. Sigma.
7. Sterling.
8. Substitutions: Refer to Section 23 05 00.

B. Coils: Seamless heavy wall copper tubing, silver brazed to copper headers, and with evenly spaced aluminum fins mechanically bonded to tubing. Factory tested at 250 psi and rated at 150 pounds of saturated steam pressure.

C. Casing: 0.0478 inch steel with threaded pipe connections for hanger rods.

D. Finish: Factory applied baked enamel.

E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

F. Air Outlet: Louvered cone diffuser on vertical models and double deflection louvers on horizontal throw models.

G. Motor: Totally Enclosed, specifically designed for unit heater service with automatic reset inherent overload protection. Motor and fan assembly resiliently mounted to eliminate vibration and minimize sound. Refer to Section 23 05 13.

H. Heating Capacity: As scheduled, at 65 degrees F air temperature and 180 degrees F average water temperature.

I. Accessories: Strap on aquastat, Thermostat with selector switches; Auto/Off/Fan.

J. Electrical: Starters and disconnects by Division 26.

2.2 CABINET UNIT HEATERS

A. Manufacturer:

1. Airtherm.
2. McQuay.
3. Rittling.
4. Sigma.
5. Sterling.
6. Vulcan.
7. Substitutions: Refer to Section 23 05 00.

B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, factory tested at 250 psig and are rated at 50 pounds of saturated steam pressure.

C. Cabinet: 16 gage steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet and inlet grilles, wall seal with gasket.

D. Finish: Factory applied baked enamel finish, color selected by Architect on visible surfaces of enclosure or cabinet from factory color chart.

E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

F. Motor: Tap wound variable speed permanent split capacitor with sleeve bearings, resiliently mounted.

G. Control: Solid state fan speed controller, factory wired, located in cabinet.

H. Filter: Easily removed 1 inch thick permanent washable type, located to filter air before coil.

I. Accessories: Return air grille, line voltage thermostat, rear perimeter gasketing, wall plate, leveling leg kit.

J. Heating Capacity: As scheduled, at 65 degrees F air temperature and 180 degrees F average water temperature.

K. Electrical: Motor starter with thermal overload protection and disconnect switch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

E. Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.

F. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. Provide with vent, if not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters.

END OF SECTION

INDEX TO ELECTRICAL SPECIFICATIONS

DIVISION 26 – ELECTRICAL

END OF INDEX

SECTION 26 01 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 SUMMARY

A. The work described in this specification applies to two (2) buildings:

- Morristown Middle School
- Waterville High School and Elementary

B. Section Includes:

1. Work consists of furnishing labor, materials, equipment and services required for the complete installation of work shown in the Contract Documents and specified in Division 26.
2. Include all parts and labor which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents. Such items include nuts, bolts, anchors, brackets, sleeves, offsets in conduit, fittings, relays, etc.
3. Some equipment and materials provided under Divisions 21, 22, 23, 25, 26, 27 and 28 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Divisions 21, 22, 23, 25, 26, 27 and 28 Contract Documents to determine where these composite crews are required.
4. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project.
5. Pay all fees and costs charged by utility company for installation of temporary utility services.
6. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.
7. Pay all fees and costs charged by utility companies for utility services.
8. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.
9. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.
10. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

C. Commissioning – Mechanical and electrical systems on this project will be commissioned by an independent commissioning agent. Scope of electrical work includes, but is not limited to the following:

1. Attending all commissioning meetings.

2. Verifying electrical connections and operation of commissioned systems, including but not limited to lighting, electrical distribution, fire alarm, security and low voltage systems.
3. Measuring, testing and documenting statuses of components within the scope of mechanical and electrical commissioning.
4. Demonstrating electrical systems to the Owner and commissioning agent.
5. Correcting Work as indicated by the Commissioning agent if also directed by the Engineer.
6. Providing written reports and test reports as indicated in specific specification sections.

D. Related Sections:

1. Divisions 0 and 1 apply to all work of Division 26 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 26 01 00 takes precedence. Section 26 01 00 specifies conditions, procedures, equipment and material particular to the electrical work and applies to all electrical work of the Contract Documents.
2. Division 0 and 1 and Section 26 01 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 26 work. Copy these documents to all Sub-contractors receiving other Sections of Division 26.
3. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.4 UNIT PRICES

1. Refer to Bid Form and Instructions to Bidders.

1.5 ALTERNATES

A. Refer to Bid Form and Instruction to Bidders.

1.6 ALLOWANCES

A. Refer to Allowances in Division 0.

1.7 REFERENCES

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

National Electric Code
State and Local Electrical Codes
International Building Code
International Fire Code
International Mechanical Code
State and Local Building Codes and Ordinances
State Industrial Commission Regulations

State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State Elevator Code
Occupational Safety and Health Administration Regulations
Americans with Disabilities Act
Uniform Federal Accessibility Standards
State Board of Health
NFPA 101 Life Safety Code
State Energy Code

D. Use the Standard where referenced in the specifications by the following abbreviations:

AIA: American Insurance Association
AIA: American Institute of Architects
ANSI: American National Standards Institute
ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM: American Society of Testing and Materials
EPA: Environmental Protection Agency
FM: Factory Mutual Insurance Association
IEEE: Institute of Electrical and Electronic Engineers
IES: Illuminating Engineering Society of North America
ICEA: International Cable Engineers Association
NBS: National Bureau of Standards
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
NSC: National Safety Council
UL: Underwriter's Laboratories
EIT/TIA Standards: Commercial Bldg Telecommunications wiring and spaces.
BICSI: Building Industry Consulting Services International.
NECA: National Electrical Contractors Association

1.8 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.

1. The work – as defined in the 2007 AIA Document A201: "The term 'Work' means the construction and services required by the Contract Documents whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project."
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.
5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.
7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.

9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. All electrical details and drawings are diagrammatic, unless specifically noted. Field-verify all dimensions and notify the Engineer of any conflicts of discrepancies, in writing, prior to installation.

1.9 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.

2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Comply with the NEC as applicable to the construction and installation of equipment specified in this section.

E. Provide equipment specified in this section that has been listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

H. Comply with NECA, NEIS (National Electrical Installation Standards) for workmanship and installation requirements.

1.10 SUBMITTALS

A. Refer to section 26 01 05, Submittals, Closeout Documents, Training and Spare Parts.

1.11 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.

2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and casual site observations, and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.

2. Install all conduit, cable tray, busduct, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.

3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.

4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.

5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.

6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.

7. Drawings and specifications are complementary and what is called for in either on is as binding as if called for in both.

8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

1.12 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls and floors.

B. Provide UL listed components installed by a certified and factory trained personnel.

1.13 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

PART 2 PRODUCTS

2.1 TAMPERPROOF HARDWARE

A. Where tamperproof hardware is called out, provide torx head with center pin reject hardware for the following electrical work:

1. Light fixture housings

2. Covers to electrical enclosures, pullboxes, cabinets, junction boxes, wireways
3. Coverplates (both maximum security and stainless steel coverplates)

2.2 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves 1 ½" larger than O.D. of pipe that adhere ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Provide minimum of three (3) concrete anchors for Schedule 40 pipe sleeves.

D. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-selection rectangle perimeter less than .50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter equal to, or more than .50 inches and 1 or more sides equal to, or more that 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Rectangular Pathways:

1. 4" x 4-5/8" nominal pathway cross section with accommodations for wall thicknesses up to 20".
2. UL tested and classified in accordance with ASTM E814 (UL1479).
3. Fire and smoke sealing system that automatically adjusts to the amount of cables installed.
4. Manufacturers:
   a. Specified Technologies Inc. (STI), "EZ-PATH 44".
   b. Approved equal.

PART 3 EXECUTION

3.1 CONSTRUCTION LIGHTING & POWER SYSTEM – REMODELING

A. Provide construction power and lighting that adheres to 2014 Article 590 – "Temporary Installations"

B. See Division 1 for temporary electrical services.

C. For remodeling work in the existing building, use existing building distribution systems for construction power.

D. Replace all receptacles, switched, coverplates, etc., damaged by any Contractor during the course of construction.

E. Materials furnished for the temporary light and power system remain Contractors property. Remove when there is no longer any need for temporary light and power or when directed by the Architect.

F. Electrical energy costs shall be paid by the Owner.

3.2 PREPARATION

A. Continuity of Service:

1. No Division 26 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.
2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.
3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.
2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.3 INSTALLATION

A. Material and Workmanship:

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.
2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.
3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.

B. Excavation and Backfilling:

1. Provide all excavation and backfilling required to complete the installation of the electrical system. Conform with the provisions of Division 31 Earthwork of these specifications for all work.
2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Engineer/Architect will inspect the excavation and determine the necessary additional support required.
3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is similar to the above. Remove all large stones, frozen lumps, perishable rubbish and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable or duct. Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Architect/Engineer reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.
4. Replace all existing surface improvements (i.e.,-street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed under a different Division.
2. Obtain special permission from the Engineer before cutting structural members or finished material.
3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
4. Patch all holes left as a result of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:

1. Refinish all electrical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.
2. Paint all new raceway systems in exposed finished areas to match existing finish.

E. Sleeves:

1. Set all sleeves true to line, grade and position and plumb or level after concrete is poured. Correct any deviation from proper position.
2. Caulk spaces between pipe and floor sleeves inside the building with a waterproof caulking material. Caulk spaces between pie and exterior partition sleeves with glass fiber insulation.
3. Tighten sleeve seal nuts until sealing grommets have expended to form watertight seal.
4. Furnish sealable penetration pockets compatible with the building roofing system where conduits pass through the roof. Turn pockets over to the General Contractor.
5. Provide fire barriers around conduit, pipe, tubing, bus ducts and cables passing through smoke and fire rated floors and walls. Provide CP 25, 303, and PSS7904 Series by 3M, or “flame-Safe” system by Thomas and Betts Corp for fire seals.
6. Subject to compliance with requirements, provide water-tight seals by Thunderline or pre-approved equal.

F. Structural Bracing:

1. Refer to Architects and Structural Engineer drawings for cross bracing within sheetrock walls. The electrical contractor is required to route conduit and conduit stubs to avoid bracing.

3.4 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls and floors.

B. Install firestopping on both sides of each partition, completely filling the void around the opening.

C. Firestopping of interior of conduits and sleeves is by the contractor providing the cabling inside the conduit or sleeve.

3.5 FIELD QUALITY CONTROL

A. Testing: Refer to Section 26 01 20: Testing and Adjustments to Electrical Systems.

B. Final Inspection:

1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an inspection and generate a list of items to be corrected or completed before Contract Closeout. If the Engineer is requested to make a final inspection by the Contractor, and the Engineer finds the work is not complete enough to perform that inspection, the Contractor will compensate the Engineer for his time. The Contractor will then perform the necessary work to complete the project and again request a Final Inspection.

3.6 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.7 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

3.8 FINAL OBSERVATION

A. A final observation of the electrical systems by the Architect/Engineer will be conducted before the contract can be considered complete. The Contractor shall inform the Engineer when the electrical installation is complete and ready for final observation. The Engineer shall visit the project and provide a list of items that need to be corrected or completed to achieve final completion. Should the Engineer attaend the project to conduct the final observation and discovers that the work is not sufficiently complete to perform this task, then the contractor shall compensated the Engineer for this time. The Contractor shall remain responsible for completing their work and requesting the Engineer to return for a final observation.

B. Submit Form 310 for Substantial Completion to the Engineer before Architect/Engineer visits site.

SUBMISSION FOR SUBSTANTIAL COMPLETION – FORM 310

Project:_____ Project Number:_____

Date:_____

Owner:_____ Contractor:_____

_____ (Contractor) is requesting substantial completion for part or all of the work on the above named project. The project is at a stage where the work within the contractor is sufficiently completed so the Engineer can make a final observation of the work and the owner can occupy. Once the Engineer has made a final observation of the project, a Certificate of Substantial completion will be filled out by Architect/Engineer and copies returned to the Owner and Contractor.

Sufficiently complete indicates that the mechanical and electrical systems are functional and all major equipment is in place and operational, with only minor items remaining incomplete. A list of items incomplete shall be listed below. All punchlists and issue tracking forms shall be completed and returned by the contractor(s) within 30 days of substantial completion. If items are found to be incomplete during the re-verification process, the contractors will be charged for the time spent by the Owner, Design Team, and Commissioning Agent, until the issues are resolved.

The electrical checklist shall accompany this form.

_____	_____	_____
Contractor Representative Name	Signature	Date

END OF SECTION

SECTION 26 01 05

SUBMITTALS, CLOSEOUT DOCUMENTS, TRAINING AND SPARE PARTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 PRIOR APPROVALS

A. Submit approval form for each request for prior approval.

B. Submit hard copy, bound, written requests to use unspecified items, to the Engineer, no later than ten (10) calendar days prior to the bid opening. Submit detailed information for proposed material or equipment specific to the project, clearly indicating all options included in the submittal.

C. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.

D. Contractor is responsible for dimensional differences, electrical requirements and any other resulting changes, when using accepted substitutions. Contractor is responsible for any additional costs incurred as a result of substitutions, including other contractors and Architect/Engineer fees.

E. Material and equipment not specified or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

1.4 PAY REQUEST COST BREAKDOWN

A. Provide Schedule of Values for the utilization of submitting a "Pay Request". Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.

B. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or requested by the Engineer.

1. General Conditions
2. Demolition
3. 600 V Conductors and Cables
4. Raceway, Fittings, and Boxes
5. Occupancy Sensors, Daylight Sensors
6. Transformers
7. Distribution Panelboards
8. Panelboards
9. Wiring Devices
10. Safety Switches
11. Motor Control Equipment

12. Surge Protection Devices
13. Gym Area Lighting Control Systems
14. Light Fixtures – exterior and interior
15. Lamps & Ballasts
16. LED Lamps and Drivers
17. Emergency Lighting
18. Exit Signs

1.5 SHOP DRAWINGS AND SAMPLES-ELECTRONIC COPY

A. Submit in accordance with the Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.

B. Submit separately-compiled electronic documents in PDF format for each submittal listed in the table at the end of this section. Combination submittals will be returned to the contractor without review. Do not combine submittals.

C. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacture, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned without review.

D. Where equipment wiring diagrams, floorplans, equipment arrangements, etc are specified as required submittals in individual specification sections, provide contractor-created documentation. Scans, copied reproductions, etc of Engineer's drawings are unacceptable and will be rejected without review.

E. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.

F. Submit all shop drawings electronically using the established file transfer system in place as part of this project. Coordinate distribution with General Contractor, other team members, etc.

G. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.

H. Shop Drawings will be reviewed by the Engineer who will attach a review letter pdf with submittal comments and with one of the following actions checked on the submittal stamp:

1. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.

2. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.

3. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.

4. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.

I. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.

J. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.

K. Refer to the end of this section for list of Shop Drawings required for this project.

L. Provide all order service, commissioning, shop drawing preparation, on-site field-service and testing, etc. for all electrical equipment and materials through local representation.

1.6 CAD DRAWING FILES:

A. The electrical CAD drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.7 DEMONSTRATION / TRAINING

A. Fully lubricate, charge, fill, etc. all equipment, per manufacture's recommendation, prior to start-up.

B. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final inspection and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

C. Fully instruct the Owner's designated operating in the operation of each electrical system at the time it is put into service. Provide instruction using competent instructors and factory-trained personnel.

D. Include documentation of instructions in the Operation and Maintenance Manuals.

E. Obtain a written statement from the Owner that his designated personnel have been instructed.

F. Refer to the end of this section for training requirements for each system

1.8 OPERATING AND MAINTENANCE MANUALS:

A. Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data shall be appropriate marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer's warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.

5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Adjustable circuit breaker and ground fault settings and field-testing procedures.
10. Local equipment suppliers/reps names, addresses, and telephone numbers.
11. Equipment manufacturers names, addresses, and telephone numbers.
12. Sub-contractors names, addresses, and telephone numbers.
13. Refer to individual Sections in Division 26 for additional requirements.
14. Test reports.

1.9 RECORD DRAWINGS

A. Provide record drawings in accordance with the requirements of Division 0, Division 1 and this section.

B. Preparation of as-built drawings does not constitute authorization to make changes unknown to or unapproved by Owner or the Owners representative.

C. As work progresses, in a neat and legible manner, record the following information on the record set of plans:

1. Update the contract documents to show all modifications including but not limited to Addendums, Change Orders, approved Proposal Requests and Architect's Supplemental Instructions. Cut and paste original documents to the as-built set.
2. Indicate exact location and depth of underground feeders to panelboards, transformers, distribution panels, generators, complete from each end. Indicate the routing of the conduits as accurately as possible, showing elbows, sweeps, and turns.
3. Provide plans that indicate exact routing of outside underground feeders and services, showing dimensions from structural foundation walls or columns. Indicate depth and type of conduits.
4. Provide plans that indicate routing of conduit from outlet to outlet, routing of conduit underfloor, overhead, in walls or exposed, combining of circuits into a common conduit, exact sizes of conduits and conductors, revisions to circuit breaker quantity or arrangement in panelboards.
5. Record exact location and elevation of underground conduits dedicated to technology systems including backbone fiber conduits, telephone conduits and cable TV conduits. Where spare underground conduits are terminated underground (i.e. property line), indicate exact dimensions from two different points of the foundation wall corner or structural columns.
6. Indicate exact locations and depth of spare conduits stubbed from concrete pole bases.
7. Record routing of cable tray where it varies from the plans.
8. Record changes to branch circuit numbers on the plan when they deviate from the circuit numbers shown on the Contract Documents.
9. Include the locations of the following devices on the record drawings:

a. Emergency Lighting Relays (Section 26 09 25) mounted above ceilings.

b. Occupancy Sensor Power Packs (Section 26 09 23) mounted above ceilings.

c. Daylight Sensor Power Packs (Section 26 09 24)

D. The Engineer will recommend withholding payment if as-built drawings are not being maintained on-site.

E. Submit record drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

1.10 DOCUMENT TURNOVER

A. Construction Documents CD's, Owner and Operation Manuals (O&M's), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Construction Documents

a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 150DPI Color

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Specifications

a. PDF Creation: All specifications shall be scanned or converted to one single PDF file.

1) Scanning:

i) 150DPI Color

b. Bookmarking: Not required.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

3. Operation and Maintenance Manuals
   a. O & M's shall be turned over by the Contractor.
   b. PDF Creation: All Operation and Maintenance Manuals shall be scanned or converted to one single PDF file.
      1) Scanning:
         i) 150DPI Color
   c. Bookmarking: Bookmarking of O & M Manuals shall be extensive.

1.11 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect unless a longer warranty period is specified in the individual specification sections or indicated in the forms table included in this section.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specifically called for.

E. Refer to the end of this section for a list of specific warranty items for each system.

1.12 FORMS

Section	Equipment	Shop Dwgs Req'd?	Warranty (all 1-year unless noted otherwise)	Owner Training	AHJ Cert. Req'd?	System Testing and report required?
26 05 19	Wire and cable	Yes		No	No	Yes
26 05 33	Surface Raceway	Yes		No	No	No
26 05 34	Technology Raceway System	Yes		No	No	No
26 05 50	Floorboxes	Yes		No	No	No
26 09 23	Occupancy Sensors	Yes	1 Yr parts &labor 5 Yrs sensor	2 Hrs	No	Yes
26 09 24	Daylight Sensors	Yes	1 Yr parts &labor 5 Yrs sensor	2 Hrs	No	Yes
26 24 16	Distribution Panelboards	Yes		No	No	No
26 24 16	Panelboards	Yes		No	No	No
26 27 26	Dimmers	Yes		No	No	No
26 27 26	Wiring Devices	Yes		No	No	Yes
26 28 13	Low Voltage Fuses	Yes		No	No	No
26 28 16	Safety Switches	Yes		No	No	No
26 29 13	Combination Starters	Yes		No	No	No
26 29 13	MSS	Yes		No	No	No
26 29 13	Overload Relays	Yes		No	No	No
26 29 13	Phase Monitoring Relays	Yes		No	No	No
26 29 13	Starters	Yes		No	No	No
26 51 13	Ballasts	Yes	5 Yrs	No	No	No
26 51 13	Lamps	Yes		No	No	No
26 51 13	Light Fixtures	Yes		No	No	No
26 52 00	Emergency Lighting	Yes	Unit Equip:3 Yrs Battery Ballasts:5 yr	No	Yes	No
26 53 00	Exit Signs	Yes	5 Yrs Unit / 10 yrs Pro-rated battery, lifetime LED	No	Yes	No

END OF SECTION

SECTION 26 01 10

SELECTIVE ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Sections 26 01 00 and all references contained therein form a part of this Section of the Specifications.

B. This Section includes all labor, material, equipment and services necessary and incidental to complete all the selective and or complete demolition and removal of electrical systems in the areas of remodeling or affected by remodeling, and the rework and extension of electrical systems indirectly affected by electrical system served "downstream" from the demolished electrical systems.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the building to determine actual conditions and extent of work prior to bidding the project. Refer any unclear details or conflicts to the Architect/Engineer for clarification prior to bidding the drawings.

B. Verify that field measurements and circuiting arrangements are as shown on Drawings.

C. Verify that abandoned wiring and equipment serve only abandoned facilities.

D. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Coordinate phasing of the demolition work with the construction sequence schedule.

B. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

C. Coordinate utility service outages with Utility Company.

D. Identify and provide new supporting means for existing electrical equipment such as low voltage cabling, conduits, boxes, pullboxes, conduit bodies, and conduit racks that will need additional support due to the demolition of the existing supports, including ceilings.

E. Erect, and maintain temporary safeguards, including warning signs and lights and barricades for protection of the public, Owner, Contractor's employees, and existing improvements to remain.

F. Provide temporary emergency lighting and illuminated exit signage as required by the Building Official or AHJ.

G. Electrical Service: Maintain existing system throughout construction in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify and obtain permission from Owner, Architect/Engineer at least 24 hours before partially or disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

H. Conduct demolition to minimize interference with adjacent and occupied building areas.

I. Perform noisy work before or after the Owner's working hours to minimum disruption.

J. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish electrical systems in walls, floors, and ceilings identified to be demolished.

B. Demolish and extend existing electrical work under and this Section or as indicated on the Drawings. Remove devices, conduit, wire, boxes, and fastening devices to avoid any interference with new installation.

C. Remove, relocate, and extend existing installations to accommodate new construction or to maintain systems downstream from demolished area.

D. Provide supports for all existing electrical equipment that was supported previously by demolished walls, floors, ceiling or other structures. Provide new supports from structural members not slated for demolition, prior to any demolition.

E. Owner reserves the right of first refusal to obtain material shown to be removed under this contract. Items not retained by the Owner become the property of the Contractor and must be removed from the premises.

F. Demolish and remove all electrical systems indicated for demolition. No portion of these systems may be abandoned in place.

G. Remove abandoned wiring to source of supply.

H. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit in walls, floors, or columns back to a point where patching can be adequately performed and patch surfaces.

I. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

J. Disconnect and remove abandoned panelboards and distribution equipment.

K. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

L. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.

M. Repair adjacent construction and finishes damaged during demolition and extension work.

N. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

O. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Relocate and reroute conduit and wiring as required for conduit concealed in walls or structure being altered as part of the remodeling. Maintain continuity to all devices in and downstream of remodeled work.

P. Reroute existing raceway and wiring which is exposed due to removal of existing construction. Conceal new raceway and wiring and maintain operation.

Q. If conductors are required to be removed from existing raceways, install with new conductors.

R. Provide new coverplates throughout the remodeled areas.

S. Dispose of fluorescent lamps, ballasts, and other hazardous materials in accordance with State and Federal regulations.

T. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finish. Cut embedded support elements flush with walls and floors. Patch surfaces.

3.4 EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Reuse breakers if possible. Provide new breakers for new equipment unless breakers are specifically noted on the plans to be reused.

B. Tag unused circuits as spare and turn breakers and/or switches off.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated directories where more than three circuits have been modified or rewired.

F. Where existing panels are indicated to be demolished, extend any remaining live circuits to the nearest suitable panelboard.

3.5 CLEANING AND REPAIR

A. Prior to reinstallation of used equipment, thoroughly inspect each item and report any defects to the Engineer/Architect in writing. Instructions for corrective measures will be given at the time and the Contract amount adjusted accordingly. If no defects are reported, the material will be included under the contractor's one year guarantee.

B. Warranty as outlined in Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaries: Where existing luminaries are indicated to be re-used, remove existing luminaries for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace non-functioning ballasts, and broken electrical parts. Provide new lamps.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.6 INSTALLATION

A. Install relocated materials and equipment as indicated on the drawings.

END OF SECTION

SECTION 26 01 20

TESTING AND ADJUSTMENTS TO ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 DESCRIPTION OF WORK

A. Testing of electrical systems.

B. Submissions of reports of tests.

PART 2 PRODUCTS

2.1 MATERIALS

A. Miscellaneous testing equipment as detailed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Test the equipment and systems and demonstrate their proper operation to the Engineer.

1. Do not test equipment until it has been fully prepared, connected, and made ready for normal operation. Repair any equipment damaged by improper operation or testing at no cost to the Owner, before final inspection and acceptance.

3.2 LIFE SAFETY LIGHTING SYSTEM TESTING

A. Unit Battery Equipment Testing

1. Test all emergency light fixtures and the Lighting Control Equipment to ensure proper operation during a normal power outage. Coordinate with the generator testing.

2. Simulate a power outage at each emergency light by turning off the normal power lighting circuit and observing the operation of the battery, and observe the lighting be energized in the room or area. Verify that the toggle switch in the same room or area cannot turn OFF the emergency lighting as long as the normal source is not present.

3. Simulate a power outage at the lighting control panel(s), and observe that the emergency relays are forced ON, energizing the life safety light fixtures controlled by the lighting control panel(s).

B. Battery Ballast Testing

1. Test all emergency lights with integral battery ballasts and the Lighting Control Equipment to ensure proper operation during a normal power outage. Coordinate with the generator testing.

2. Simulate a power outage at each emergency light by turning off the normal power lighting circuit and observing the operation of the battery, and the observe the lighting be energized in the room or area. Verify that the toggle switch in the same room or area cannot turn OFF the emergency lighting as long as the normal source is not present.

3. Simulate a power outage at the lighting control panel(s), and observe that the emergency relays are forced ON, energizing the life safety light fixtures controlled by the lighting control panel(s).

C. A full functional test of all emergency lighting systems will be made in the presence of the Engineer.

D. Provide a certification of verification with the operating and maintenance manual confirming that the emergency lighting system has been tested and functions correctly and conform to all local codes.

3.3 FEEDER TESTING

A. Megger all lighting and power circuit feeders. If insulation resistance on any circuit is less than 1 megohm, such circuits are to be considered defective and must be replaced. Submit test results for each phase of each feeder from the output report files of the tester. Document all readings and submit to the Engineer.

3.4 OVERALL ELECTRICAL SYSTEM

A. Conduct voltage tests at the time of energization of the distribution system, in the presence of the Engineer and carry out such corrective measures as may be required.

B. Adjust all systems and leave in proper operating condition.

C. Test all wiring and leave free of defective installation and unintentional grounds.

D. Balancing Three Phase Loads

1. Prior to turning the building over to the Owner turn on all equipment in the building including lighting and with an amprobe, read the current drawn on each hot leg of feeder supplying each distribution panel. If the current in any one leg varies more than 5% (plus or minus) from the arithmetic average of the current in all the hot legs, reconnect the branch circuits to obtain a balanced loading.

3.5 GROUNDING ELECTRODE TESTING

A. Perform ground resistance testing in accordance with IEEE 142 at the main service grounding electrode.

3.6 OCCUPANCY SENSOR TESTING

A. Upon completion of the installation phase, test and adjust each occupancy sensor to insure proper operation.

B. General rooms and offices: Set the time delay to OFF as indicated in the sequence of operations on the drawings. Set the sensitivity of each device to trip the lights ON from anywhere in the room, but not so sensitive to trigger the lights on from motion outside the room.

C. Corridors and hallway: Set the time delay to OFF as indicated in the sequence of operations on the drawings. Set the sensitivity of each device to trip the lights ON from anywhere in the corridor/hall.

D. For dual technology sensors, set the sensor to maintain an ON condition if either technology is triggered from within the room after an initial ON. Set the device to initiate an ON condition only if both technologies sense motion from within the room.

E. Test all operational features of the system at this time.

F. Where required, make appropriate correction(s) and adjustments.

3.7 DAYLIGHT SENSOR TESTING

A. Upon completion of the installation phase, test and adjust each daylight sensor to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

D. Specific adjustments:

1. At night (or with the shades closed) set a digital light meter at floor level, and while increasing the light level in the space, set the ON, OFF and deadband footcandle setpoints to the levels specified.

E. Repeat adjustments for all spaces.

3.8 LIGHTING CONTROL SYSTEM TESTING

A. Refer to specific section for requirements.

END OF SECTION

SECTION 26 05 19

600 VOLT CONDUCTORS AND CABLES

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 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. This section includes these materials as defined by the 2014 NEC:

1. Multi-Wire Branch Circuit: (NEC Article 210.4)
2. Conductors for General Wiring (NEC Article 310)
3. Metal Clad Cable: Type MC (NEC Article 330)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 CONDUCTORS

A. Provide copper conductors with 90ºC insulation system, 600 volt rating, U.L. approved and listed for specific application. Aluminum conductors are not allowed

B. Indoor, dry location, single conductor, insulated wire.

1. Provide THHN, THHW, THWN-2, XHHW, XHHW-2 insulation.
2. No. 12 AWG and No. 10 AWG or smaller: Provide solid conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

C. Underground or wet location, single conductor, insulated wire.

1. Provide THHW, THWN-2, XHHW, XHHW-2 insulation
2. No. 12 AWG and No. 10 AWG: Provide solid or stranded conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

D. Provide conductors for other systems as specified in the section in which they are described.

E. Provide minimum No. 12 AWG conductor size, unless noted otherwise.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. Class 2 Control Circuits: Type THHN-THWN, in raceway.

H. Acceptable manufacturers

1. Southwire
2. Essex

3. General Cable

I. Copper Conductors: Comply with NEMA WC 70

PART 3 EXECUTION

3.1 CABLE CONDUCTOR INSTALLATION

A. Encase all conductors in a continuous raceway system.

B. Examine all conductor before installation. Do not use any conductor with insulation that is damaged in any way.

C. Do not pull conductor into the conduit until the conduit system is complete. Pull all conductors into raceway at the same time.

D. Route one A phase conductor and one B phase conductor and one C phase conductor (and neutral and grounding conductors if applicable) within the same raceway for each of the parallel raceways. Provide identical length conductors for all phases and neutrals for each parallel feeder.

E. Test all cable and wire for continuity and for shorts prior to energizing any circuits.

F. Provide separate hot, neutral and ground conductors for each circuit wired to Technology Panelboards.

G. Provide separate hot and neutral conductors for each multi-conductor branch circuit. Do not share neutral conductors.

H. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Provide conductors color coded as follows:

1. 208/120 Volt Systems
    a. Phase A - Black.
    b. Phase B - Red.
    c. Phase C - Blue.
    d. Neutral - White.
    e. Ground - Green.
2. 480/277 Volt Systems
    a. Phase A - Brown.
    b. Phase B - Orange.
    c. Phase C - Yellow.
    d. Neutral - Gray.
    e. Ground - Green.

K. All Conductors are No. 12 AWG copper unless indicated or specified otherwise.

L. All conductor sizes indicated on the drawings are based on copper conductors. Do not substitute smaller conductors with higher temperature rated insulation.

M. Maximum number of conductors in raceways and boxes shall conform to the requirements of the National Electrical Code. Neatly trim and lace wiring inside boxes, equipment, and panels.

N. If copper-clad aluminum, or aluminum alloy conductors are used in lieu of copper conductors, the conductor size must be adjusted to provide equal or greater ampacity of the conductor indicated. This adjustment shall be based on using the ampacity for the equivalent insulation of the conductor indicated.

O. If copper clad Aluminum or aluminum-alloy conductors are used, all raceways must be adjusted to accommodate increased conductor sizes.

P. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.2 SPLICES, TAPS AND TERMINATIONS

A. Splices to feeders and service entrance conductors are not permitted unless specifically noted on the plans.

B. Provide "pigtail"type splices and taps in conductor No. 8 AWG and smaller. Use "wire-nut" self insulating connectors.

C. Use pressure or compression type connectors for all splices or taps in copper conductors.

D. Do not splice conductors of dissimilar metals together.

E. Use only compression type connectors for all splices, taps, and terminations using copper-clad aluminum or aluminum alloy conductors.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

G. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

3.3 ADJUSTING AND TESTING

A. Test all wiring and leave free of defective installation and unintentional grounds.

B. Refer Section 26 01 20: “Testing and Adjustments to Electrical Systems”.

END OF SECTION

SECTION 26 05 24

CONNECTIONS TO EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division 21, 22, 23, 25 and 26 section making reference to electrical connections for equipment specified herein.

1.2 DESCRIPTION OF WORK

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. From electrical source to motor starters.
2. From motor starters to motors.
3. To lighting fixtures.
4. To lighting control system terminations and control devices.
5. To temperature control equipment.
6. To miscellaneous equipment forming part of other divisions.

C. Make electrical connections to all motors, appliances and other equipment and the associated control devices in accordance with the schedules on the drawings and as hereinafter specified.

1. In each case verify connections and physical data from approved shop drawing, manufacturers' wiring diagrams and/or detail drawings provided by relevant trade subcontractor.
2. Make connections to all motors and equipment furnished and set in place by others. Provide starters, manual controls and auxiliary equipment where indicated in schedules and specified herein. Provide all disconnect switches as indicated in schedules, specified herein and required by code.

D. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division 21, 22, 23, 25 and 26 sections, and are work of this section.

E. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division 26 sections.

F. Refer to Division 21, 22, 23 and 25 sections for connection requirements for temperature control equipment.

G. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division 26 sections.

H. Electrical identification for wire/cable conductors is specified in Division 26 section, "Electrical Identification".

I. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 26 sections.

J. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE

A. Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

B. Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

C. Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are listed and labeled by nationally recognized testing laboratories.

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Provide complete assembly of materials, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations for each electrical connection indicated.

B. Raceways and Fittings:

1. Provide raceways and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division 26 basic electrical materials and methods section "Raceways".

C. Conductors, Cables and Connectors:

1. Provide wires, cables, and connectors complying with Division 26 basic electrical materials and methods section "Wires and Cables".

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. Install electrical connections as indicated; 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.

B. Coordinate with 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. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

E. 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.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. 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 torquing 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 torquing values contained in UL's 486A.

H. Provide flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes”

I. Fasten identification markers to each electrical power supply wire/cable conductor in accordance with “Section 26 05 53: Identification for Electrical Systems.” Affix markers on each terminal conductor, as close as possible to the point of connection.

3.3 CONNECTIONS TO LIGHTING CONTROL SYSTEM EQUIPMENT

A. Make electrical connections required for a complete operating system. Follow manufacturer's written instructions. Coordinate with the manufacturer.

3.4 CONNECTIONS TO TEMPERATURE CONTROL EQUIPMENT

A. Make electrical connections as indicated in the plans and specifications to temperature control devices according to the manufacturer’s written instructions. Coordinate with Divisions 21, 22, 23 and 25.

3.5 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.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL 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 REFERENCES

A. Grounding and Bonding (NEC Article 250)

B. Section 26 05 53: Identification for Electrical Systems

1.3 DESCRIPTION

A. Grounding Electrode System

B. Equipment Grounding Conductors.

C. Main Bonding Jumpers, Supply-Side Bonding Jumpers, and System Bonding Jumpers

D. Telecommunications Grounding System

E. Connections to Systems

1.4 SUBMITTALS

A. Submit shop drawings and descfiptive data in accordance with Section 26 01 05: "Submittlas, Closeout doucments, Trainng and Spare Parts".

PART 2 EQUIPMENT

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 GROUND RODS

A. Ground Rods: Copper-clad stainless steel, sectional type; 3/4 inch by 10 feet 5/8 by 96 inches in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturers recommended material.

C. Acceptable Manufactures:

1. Erico
2. Approved Equal

2.3 GROUNDING CONNECTORS

A. Clamps and pressure connectors.

1. Clamps for connection to piping and conduit, OZ Gedney type ABG or equal.
2. Clamps for connection to enclosures and buswork, OZ Gedney type KGM or equal.

B. Welded connections using non-reversable exothermic process. Acceptable manufacturers: Cadweld, Thermoweld.

2.4 GROUND BUSBAR

A. Solid copper grounding busbars, minimum ¼" thick, in sizes as shown on the drawings or otherwise specified in part 3 below.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/2 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Compliant with ASTM®B187-C11000.

D. 2" Polyamide Standoff Isolators with 1/8" stainless steel brackets and stainless steel fasteners.

E. For use with two-hole connector lugs as specified in paragraph 2.5.

F. Acceptable Manufactures:

1. Erico
2. Approved Equal

2.5 GROUNDING LUGS

A. Acceptable Manufacturers:

1. Thomas and Betts
2. ILSCO
3. Approved equal

B. Acceptable Materials:

1. Two hole compression lugs: Thomas and Betts, "Two Hole Lugs Long Barrel Type" color code blue 54800 series, high conductivity wrought copper, electro tin plated, or approved equal.

PART 3 EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

A. Grounding Electrode Conductors. Provide grounding electrode conductors, sized at minimum sizes required by NEC Article 250 and NEC Table 250.66 or as otherwise shown on the drawings.

1. Provide a grounding electrode conductor from each of the grounding electrodes listed in Paragraph 3.1.C below to the Grounding Electrode System Busbar.
2. Provide a properly-sized bonding jumper over water meters and similar equipment on water main services.
3. At each separately-derived 3 phase/4 wire wye-secondary service derived from a transformer, provide an unspliced Grounding Electrode Conductor from the transformer XO terminal (Neutral) to the nearest grounding electrode (building steel, ground bar, or as otherwise indicated on the drawings).
4. Provide a grounding electrode system conductor from the Grounding Electrode System Busbar to the service entrance equipment ground busbar.
5. Provide a grounding electrode conductor from the TMGB to the Grounding Electrode System Busbar.
6. Comply with NEC 250.64 (B) for securing and protection of grounding electrode conductors against damage.

B. Grounding Electrode System Busbar

1. Provide a 4”x24” grounding busbar, located as shown on the drawings and connect grounding electrode conductors from the electrodes/connections specified in Paragraph 3.1.A.

C. Grounding Electrodes

1. Provide a minimum of 20'-0” of #3/0 concrete-encased electrode installed within the foundation of the building, tied to the steel reinforcing, in accordance with NEC section 250.50.
2. Underground metal water piping within 10’-0” of the point of entrance.
3. Metal frame of building or structure.

D. Minimum of three (3) ground rods, or as otherwise shown on the drawings, installed in equilateral triangular fashion, spaced at a minimum of 10’-0” center to center of rods. Bond all rods utilizing Grounding Electrode Conductor.

3.2 EQUIPMENT GROUNDING CONDUCTORS/EQUIPMENT GROUNDING

A. Provide equipment grounding conductors, sized as shown on the drawings or at minimum sizes required by NEC Table 250.122. Solidly ground all conduit systems, switch boxes, cabinets, motor frames, switchgear, transformers, and all other permanently installed equipment to form a continuous, permanent and effective grounding system. Bond expansion joints and metal raceway sections.

B. Provide equipment ground conductors in all feeder and branch circuits. Use of raceway systems to serve exclusively as equipment ground conductors is prohibited.

3.3 MAIN BONDING JUMPERS, SYSTEM BONDING JUMPERS, AND SUPPLY-SIDE BONDING JUMPERS

A. Provide bonding jumpers, sized as shown on the drawings or at minimum sizes required by NEC Table 250.102(C)(1), at each of the following locations:

1. At the electrical service, provide an unspliced main bonding jumper to connect the equipment grounding conductor(s) and service disconnect enclosure to the grounded conductor (neutral) within the service enclosure (if manufacturer-provided N-G bond is not installed).

2. At each separately-derived 3 phase/4 wire wye-secondary service derived from a transformer, provide:

    a. An unspliced system bonding jumper from the transformer X0 terminal (neutral) to the transformer ground bar or enclosure (as provided).

    b. As part of the associated secondary feeder, provide an unspliced supply-side bonding jumper from the transformer X0 terminal (neutral) to the ground bus of the secondary overcurrent device enclosure, and from this ground bus to the enclosure of the secondary overcurrent device. See Feeder Schedule on drawings for requirements.

    c. See Grounding Electrode System for Transformer Secondary Grounding Electrode Connections.

3.4 CONNECTIONS TO OTHER SYSTEMS

A. Refer to specific systems equipment sections for additional grounding and bonding information.

3.5 FIELD QUALITY CONTROL/TESTING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 IDENTIFICATION

A. Comply with requirements in Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

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 REFERENCES

A. 26 01 00: Common Work Results for Electrical

B. 26 05 33: Raceways, Fittings, and Boxes

C. 26 05 34: Technology Raceway System

D. 26 05 35: Wireways

E. 26 51 13: Lighting

F. 26 52 00: Emergency Lighting

G. 26 53 00: Exit Signs

1.3 DESCRIPTION OF WORK

A. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. Clevis hangers
2. Riser clamps
3. C-clamps
4. I-beam clamps
5. One-hole conduit straps
6. Two-hole conduit straps
7. Round steel rods
8. Expansion anchors
9. Toggle bolts
10. Wall and floor seals

B. Supports, anchors and sleeves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 26 sections.

1.4 QUALITY ASSURANCE

A. Provide supporting devices, of types, sizes, and ratings required that are manufactured by firms regularly engaged in the manufacture of such devices.

B. Comply with NEC as applicable to construction and installation of electrical supporting devices.

C. Comply with applicable requirements of ANSI/NEMA std Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies".

D. Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports and equipment mounting.

E. Provide electrical components which are UL-listed and labeled.

PART 2 PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of device meets indicated requirements, selection is Installers' option.

B. Provide supports and anchors constructed of stainless steel or equivalent corrosion resistant material in chemical storage rooms.

C. Provide supporting devices of types, sizes and materials indicated, and having the following construction features:

1. Provide clevis hangers for supporting 2" rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
2. Provide riser clamps for supporting metal conduit; black steel; with 2 bolts and nuts, and 4" ears.
3. Provide C-clamps of black malleable iron; 1/2" rod size.
4. Provide I-Beam clamps of galvanized steel, 1-1/4" x 3/6" stock; 3/8" cross bolt; flange width 2".
5. Provide one-hole conduit straps for supporting metal conduit; galvanized steel.
6. Provide two-hole conduit straps for supporting metal conduit; galvanized steel; 3/4" strap width.
7. Provide hexagon nuts for 1/2" rod size; galvanized steel.
8. Provide round steel rod of galvanized steel; 1/2" dia.

D. Provide anchors of types, sizes and materials indicated; and having the following construction features:

1. Expansion Anchors: 1/2".
2. Toggle Bolts: Springhead; 3/16" x 4".

E. Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, or types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:

1. Fixture hangers
2. Channel hangers
3. End caps
4. Beam Clamps
5. Wiring stud
6. Thinwall conduit clamps
7. Rigid conduit clamps
8. Conduit hangers

9. U-bolts

PART 3 EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hanger, anchors and sleeves in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements of NECA, NEC and ANSI/NEMA. Extend sleeves 3/4" above floor surface.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Support suspended conduit runs threaded rod and galvanized conduit hangers. Attach the hanger rod to concrete structural members with malleable iron inserts, to existing or precast concrete structural members with self-drilling anchors, to structural steel with steel "C" clamps, and to wood with suitable sized lag screws and angles. Support multiple parallel conduit runs on trapeze hangers constructed of steel rod hangers and structural channel. Include three (3) nuts jam-locked, on all threaded rod hangers, to rigidly support the conduit. Install supports with maximum spacings indicated.

D. Support surface mounted conduit runs with galvanized pipe straps. Fasten pipe straps to masonry surfaces with self-drilling anchors or toggle bolts. Fasten pipe straps to wood or sheetmetal surfaces with pan head sheetmetal screws.

E. Support wall mounted electrical equipment on 3/4" thick C-D exterior fir plywood painted with two (2) coats of ASA-49 gray enamel.

F. Provide stainless steel screws where electrical equipment is mounted on or attached to fire treated plywood. Hold equipment away from the plywood with either plastic or stainless steel washers or spacers.

G. Support all ceiling mounted receptacles with a listed tile bridge spanning the suspended ceiling grid, plus a 1/4" threaded rod anchored to a structurally sound member directly above the outlet box.

H. Provide finish of supporting devices in the chemical storage room as follows:

1. Provide PVC-coated galvanized concrete inserts and pipe straps.
2. Provide stainless steel for all bolts, nuts, washers, and screws.
3. Provide PVC-coated individual hangers and trapeze hangers.
4. Provide individual galvanized rods with two (2) coats of epoxy paints.

3.2 LIGHT FIXTURE SUPPORTS

A. Securely support all light fixtures directly from building structural members or 11/2” or larger steel ceiling framing channels. Use steel channel equivalent to Kindorf #6029 where it is necessary to span the building structural members for fixture support. Wood supporting members or wires will not be acceptable. Provide minimum ¼” diameter lag screws when anchoring into wood structural members. Penetrate wood structural members a minimum of 2” with all screws. Provide steel or lead, expandable type, anchors with minimum penetration of 11/2” when anchoring to concrete.

B. DO NOT suspend any conduit, light fixtures, or ballasts from metal roof deck or from the ceiling suspension wires. Support all lay-in fixtures independent of the ceiling support system. Provide fastening clips on each corner of each fixture.

C. Equip all fixtures using conduit stems with ball swivel hangers. In finished areas, provide canopies for the hangers.

D. Support all surface mounted fluorescent fixtures with a minimum of one hanger per fixture plus one per row. Support individual fixtures with a minimum of two hangers. Attach fixture hangers to the ceiling grid per code.

E. Support all suspended fluorescent fixtures with a minimum of two fixture hangers. Attach each hangar to a dedicated anchor. Locate hangars directly above the corners of the light fixtures.

END OF SECTION

SECTION 26 05 33

RACEWAYS, FITTING, AND BOXES

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 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 26: Grounding and Bonding for Electrical Systems

C. Section 26 05 29: Supporting Devices

D. Section 26 27 26: Wiring Devices

E. Intermediate Metal Conduit (NEC Article 342).

F. Rigid Metal Conduit (NEC Article 344).

G. Flexible Metal Conduit (NEC Article 348).

H. Liquidtight Flexible Metal Conduit (NEC Article 350).

I. Rigid Nonmetallic Conduit (NEC Article 352).

J. Electrical Metallic Tubing (NEC Article 358).

K. Multioutlet Assembly (NEC Article 380)

L. Surface Metal Raceways (NEC Article 386)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a coordinated, dimensioned plan drawing prior to installation that indicates the following information:

1. Routing of all underground feeders to-and-between all panelboards, switchboards and distribution panels. Indicate locations where feeders rise up through the floor and transition to overhead feeders.

2. Routing of all overhead feeders to panelboards, switchboards and distribution panels. Indicate locations of all pullboxes and sizes.

3. Routing of all underground conduits exterior to the building.

C. Precast Concrete:

1. Submit a coordinated set of shop drawings with the precast manufacturer, that indicates electrical box locations, cabinet locations and conduit routing locations.

PART 2 PRODUCTS

2.1 CONDUIT AND TUBING AND FITTINGS

A. Steel Rigid Metal Conduit (RMC) and fittings.

1. Provide hot-dip galvanized or electro-galvanized (inside and outside) conduit having a bichromate finish conforming to UL standard UL-6.
2. Provide zinc coated, threaded type fittings, couplings, and bushings.

B. PVC-coated Steel Rigid Metal Conduit (RMC) and fittings.

1. Provide hot dip galvanized or electro-galvanized rigid steel conduit.
2. 40 mil. PVC coated inside surface and outside surface.
3. Provide threaded type fittings, couplings and bushings with the same coating as the conduit.
4. Provide brush-on PVC touch-up compound.
5. Comply with NEMA RN-1.

C. Intermediate Metal Conduit (IMC) and fittings.

1. Provide hot-dip galvanized steel conduit conforming to UL Standard 1242 and Federal Specification WW-C-581E.
2. Provide zinc coated, threaded type fittings, couplings, and bushings.

D. Electrical Metallic Tubing (EMT) and fittings.

1. Provide electro-galvanized tubing conforming to UL Standard UL797, with the interior having a smooth coating of aluminum lacquer or enamel.
2. Do not thread tubing.
3. Provide concrete-tight steel compression or set-screw type fittings, couplings and bushings. Cast or indentor type devices are not acceptable.

E. Flexible Metal Conduit (FMC) and fittings.

1. Provide Type U.A., hot-dip galvanized tubing conforming to U.L. Standard ULI.
2. Provide steel or malleable iron type fittings, couplings and bushings. Cast type devices are not acceptable.

F. 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. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. O-Z/Gedney; a brand of EGS Electrical Group.
3. Republic Conduit.
4. Robroy Industries.
5. Thomas & Betts Corporation.

2.2 OUTLET AND JUNCTION BOXES

A. Provide galvanized code gauge metal outlet and junction boxes with screw-on covers of type, shape and size listed for each application.

B. Provide gasketed covers in damp and dusty locations, and also where required to meet the listed use (i.e. wet locations).

C. Provide cast metal boxes (FS and FD) for all locations where IMC and RMC is required under Section 26 05 33 under the Raceway Application Table.

D. Provide 4" square, welded minimum trade size square boxes for all outlet and junction boxes. Provide appropriate mudrings, tile rings or raised covers, depending on the application and allowable installation.

E. Provide 4 11/16" square minimum trade size boxes where indicated on the drawings (edit – rare). Provide with minimum 1" knock-outs.

F. Provide 3½" deep boxes where installed in masonry, including precast construction. Provide 2⅛" minimum deep boxes where installed in non-masonry locations. Shallower boxes (1½", 1¼") are allowed only at locations where the wall cavity depth does not permit deeper boxes to be installed concealed within the wall.

G. Provide outlet boxes with green grounding pigtail pre-terminated to the interior of the box, to be used to ground the wiring device(s).

H. Refer to other sections for additional outlet box requirements specific to other systems.

I. Approved steel box manufacturers:

1. Raco
2. Steel City
3. Pre-approved equal

J. Approved cast metal box manufacturers:

1. Appleton
2. Crouse-Hinds
3. Killark
4. Bell
5. Red Dot
6. Pre-approved equal

2.3 INTERIOR PULLBOXES

A. Provide listed metal boxes with removeable screw-on covers.

B. Size pullboxes boxes to adhere to the NEC.

C. Provide enclosures that have a NEMA rating that meet or exceed the environment in which they are installed.

D. Approved manufacturers:

1. Hoffman Enclosures
2. Electro Mechanical Industries (EMI)
3. American Midwest Power (AMP)
4. Pre-approved equal

2.4 CONDUIT BODIES

A. Provide malleable cast iron or aluminum conduit bodies of type, shape and size required to suit each installation and conduit system. Do not use conduit bodies for conduits larger than 1½" unless specifically allowed on the plans.

B. Approved manufacturers

1. Appleton
2. Crouse-Hinds
3. Killark
4. Bell
5. Red Dot
6. Pre-approved equal

2.5 SURFACE RACEWAY – SINGLE CHANNEL

A. Surface Metal Raceway

1. Single-channel, metal paintable two-piece raceway.
2. Matching fittings, coverplates, boxes, endcaps, connectors and accessories to provide a complete system.
3. Ivory-colored factory-painted raceway, boxes, fittings and hardware.
4. Listed for the rated voltage of the wiring installed in the raceway.
5. Approved Manufacturers:
   a. Wiremold 200/500/700 series
   b. Pre-approved equal

PART 3 EXECUTION

3.1 RACEWAY USAGE TABLE

A. Refer to table at the end of section for allowable usages of raceways and conduit.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Refer to Section 26 05 29: "Supporting Devices" for supporting requirements.

C. Install all line voltage (120, 208, 277 and 480 volts) conductors in a continuous raceway system. Refer to individual low voltage and communications specification sections for raceway requirements for non-line voltage wiring.

D. Provide pull and junction boxes as required by the NEC.

E. Provide minimum 3/4" conduit size for branch circuit homeruns. Provide minimum 1/2" conduit size everywhere else.

F. Verify conduit sizes indicated on the plans prior to installation. Provide proper size conduit based on the NEC maximum fill requirements, including any derating factors. Where conduit sizes are indicated on the plans, it is a minimum size allowed and it is based on based on EMT usage. If other allowable types of conduits are used, it is the Contractor's responsibility to provide the proper conduit size, including any grounding conductors and flexible connections to equipment.

G. Do not route any conduits across rooftops, unless specifically allowed and noted on the plans to do so. If conduits are allowed to be routed across rooftops, install conductors in Rigid Metal Conduit and provide proper derating of the conductor ampacities to account for the high ambient temperature as required in NEC Art. 310-15. Mount on roof blocks specifically designed for the intended environment.

H. Support all trapezes and all above-ground conduits from the building structure. Provide conduit supports, not to exceed 7' 0", for all conduit less than 1" in diameter.

I. Route all horizontal raceway above water piping, where possible.

J. Do not support conduit with wire, nylon ties, nor perforated pipe straps. Remove wire used for temporary supports.

K. Do not attach conduit to ceiling support wires.

L. Conceal all conduit work in new construction, except mechanical rooms. Conduit and boxes in mechanical spaces may be run exposed. Run all exposed conduit in a neat, workmanlike manner parallel to the building lines, tight to the wall and ceiling surfaces, and firmly support with conduit clamps or hangers. Provide one (1) hole mounting straps, minimum three (3) feet on center, for all surface conduit mounted on walls less than six (6) feet above finished floor.

M. Do not run conduits in columns except to feed column mounted devices. Do not route conduit through structural slabs, beams, or columns, unless approved by the Structural Engineer. Do not route any conduit in any concrete topping.

N. Place conduits at least 8" away from all hot piping and surfaces including domestic hot water lines. Do not route conduits through the same penetrations through floors and walls as mechanical piping unless noted otherwise or if approved by the Engineer.

O. Do not mount conduit on mechanical equipment except where necessary to connect electrical devices mounted on the equipment. Provide flexible conduit in all runs "bridging" vibration mountings.

P. Do not run conduit on or directly in front of access doors, removable panels, equipment removal spaces, control devices or other spaces necessary for normal maintenance and repair of the equipment.

Q. Install all exterior underground branch circuit conduits continuous from the source to the load. Do not install in-ground boxes as pull boxes. Oversize the conduits if required.

R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Install exterior underground conduits to drain away from the building.

S. Provide suitable fittings to accommodate expansion, contraction and deflection where conduits cross seismic, control and expansion joints. Avoid crossing expansion joints where possible.

T. Cap or plug conduit ends during construction. Cap or plug ends of conduit that are to remain empty and make watertight. Clean and swab conduits prior to pulling in conductors.

U. Provide nylon pull string in all empty conduit with a stamped plastic label indicating future use.

V. Provide watertight seal, approved by the Architect, for all roof penetrations.

W. Provide air tight seals for all raceway penetrating air plenums. Repair all damage to insulation and vapor barriers. Seal vapor barriers tight to conduit penetrating vapor barriers.

X. Seal all conduit penetrations of smoke or fire rated walls or floors with intumescent type fire barriers, 3M or equal.

Y. Seal all conduits where they pass through exterior walls and where they enter exterior fixtures.

Z. Seal all conduits where temperature differential between adjacent spaces is greater than 30 degrees Fahrenheit.

3.3 OUTLET AND JUNCTION BOX INSTALLATION

A. Maintain accessibility to all outlet and junction boxes as required by the NEC.

B. Provide recessed outlet boxes in all new construction, except mechanical rooms. Outlet boxes in mechanical rooms may be installed exposed.

C. Provide concealed junction boxes in all new construction, except mechanical rooms. Junction boxes in mechanical rooms may be installed exposed.

D. Mounting heights indicated on the drawings are from the center of the outlet box to the finished floor directly below the outlet. Exterior heights are from inside adjacent door, or if no door, from the first floor above grade, unless noted otherwise.

E. Coordinate the location of all outlets with Architectural and Mechanical drawings before installation. Verify mounting heights and locations of all outlet boxes, including the following:

1. Outlets located on walls with baseboard radiation. Mount to the side of radiation covers.
2. Switch boxes at doors. Verify door swings. Install switchboxes on the latch side of the door if possible.
3. Outlet boxes at casework. Mount outlet boxes above counters and above backsplashes.
4. Outlet boxes at undercounter refrigerators. Mount outlet boxes in the space reserved for the refrigerator.
5. Outlet boxes adjacent to marker boards or other wall-hung Architectural items. Verify top edge and bottom edge of wall-hung items and mount outlets on clear wallspace.

F. Do not mount boxes back-to-back and nippled together.

G. Do not use through-wall boxes unless specifically called out on the plans.

H. Field-gangable boxes are not allowed. Provide manufactured, multi-gang boxes.

I. Provide separate switch boxes for lighting dimmer switches to maintain full dimmer rating.

J. Close openings in all outlet boxes during plaster and concrete work with plain paper or slip-on plastic or metal plates.

K. Provide knockout closures to cap used knockout holes.

L. Provide FS and FD boxes in wet, damp and exterior locations.

M. Maintain vapor barriers around boxes and/or provide suitable boxes listed for use in vapor barriers.

N. Provide air-tight seals for all boxes in air plenums that can allow air to pass through connecting conduit. Repair all damage to insulation and vapor barriers.

O. Where boxes and concrete are installed in masonry, provide listed equipment or the means acceptable to the AHJ necessary to provide concrete-tight connections and boxes required by the NEC.

3.4 INTERIOR PULLBOX INSTALLATION

A. Provide concealed pullboxes in all new construction, except mechanical rooms. Pullboxes in mechanical rooms may be installed exposed.

B. Terminate all conduits at cabinets and boxes with locknuts and bushings. Provide insulating bushings on all conduit 1" and larger.

C. Provide pull boxes in accessible locations. Provide accessiblility to the pullbox cover. Coordinate location of pull/junction boxes with other divisions (trades) prior to installation. Do not locate pull boxes in exposed finished spaces without the specific approval of the Engineer and Architect.

D. Provide ½" clear space behind boxes when mounting in wet or damp locations.

3.5 CONDUIT BODY INSTALLATION

A. Provide conduit bodies in accessible locations. Provide accessiblility to the cover. Coordinate location of conduit bodies with other divisions (trades) prior to installation. Do not locate conduit bodies in exposed finished spaces without the specific approval of the Engineer and Architect.

3.6 SURFACE RACEWAY INSTALLATION

A. Coordinate frames with technology cabling installer, and provide the proper frame and coverplate.

B. Provide surface raceway for lighting, power, low voltage systems and technology systems in finished areas of existing construction, or at other locations specifically called out on the plans. Surface raceway is not allowed in areas of new construction unless specifically called out on the plans.

C. Verify routing of surface raceway with the Architect, Owner and Engineer prior to installation. Route surface raceway orthogonal to building lines.

D. Provide the shortest lengths of surface raceway possible, following building lines. Route raceway into accessible ceiling space and/or accessible tunnel space.

E. Unless specifically sized on the plans, use the smallest (cross-sectional area) size raceway for the use or number of conductors installed in the raceway.

F. Provide bushing on raceways stubbed into ceiling spaces for technology cabling.

G. Do not route surface raceway through walls or floors.

H. Use manufacturer's base and cover cutter to make field cuts to the raceway.

I. Ground and bond all metal raceways.

3.7 IDENTIFICATION

A. Provide identification of each junction box and pullbox located in accessible areas (i.e. above accessible ceilings) in accordance with Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

3.8 RACEWAY APPLICATION TABLE

Raceway Type→ Application ↓	Steel RMC	Alum. RMC	PVC-coated RMC	IMC	EMT	FMC	LFMC	RNMC	Surface Metal Raceway	Surface Non-metallic Raceway
Dry, concealed interior locations not listed below	A	A		A	A					
Exposed exterior locations	A		A							
Exposed unfinished interior locations installed below 46" above finished floor	A			A						
Exposed unfinished interior locations installed above 46" above finished floor					A					
Underground or under concrete slabs on grade	A		A					A[1]		
Inside exterior masonry wall cavities	A			A						
Wet Locations	A		A							
Exposed inside tunnels	A		A	A						
Motor Connections – dry locations						A[2]				
Transformer Connections – dry locations						A[2]				
Non-Transformer Vibrating Equipment – dry locations						A[2]				
Motor Connections – wet or damp locations							A[2]			
Transformer Connections – wet or damp locations							A[2]			
Vibrating Equipment – wet or damp locations							A[2]			
Lay-in light fixture connections						A[3]				
Service entrance feeder			A					A[4]		
Floorboxes in slab on grade	A		A					A[1]		
Floorboxes in concrete topping above grade			A					A		
Exposed finished areas									A[55]	A[5]
Voltages over 600 volts	A									
Lightning Protection System downlead conduits								A[6]		

Legend: A=Acceptable; (blank) = Not Acceptable

[1] Provide PVC Coated RMC elbows for all elbows installed under and/or through concrete slabs on grade.
[2] Provide conduit minimum length of 18" and a maximum length of 48".
[3] Provide maximum 6' long whip from outlet box located at building structure.
[4] Provide concrete-encased ductbank with PVC-coated Steel RMC elbows. Steel RMC elbows not required if the entire elbow is encased in concrete.
[5] Provide surface raceway only in areas of existing construction where recessed conduit and boxes are not possible.
[6] Install raceway in non-plenum spaces only.

SECTION 26 05 34

TECHNOLOGY RACEWAY SYSTEM

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 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 26: Grounding and Bonding for Electrical Systems

C. Section 26 05 29: Supporting Devices

D. Section 26 05 33: Raceways, Fittings, and Boxes

E. Section 26 05 50: Floorboxes

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a coordinated, dimensioned plan drawing prior to installation that indicates the following information:

1. Routing of all underground conduits to-and-between data rooms. Indicate locations where conduits rise up through the floor and transition to overhead conduits.

2. Routing of exterior conduits used for utility entrance cables (CATV, Telephone, Fiber, Outside Plant cables, spares, etc.).

3. Routing of all overhead backbone conduits to-and between data rooms. Indicate locations of all pullboxes and sizes.

1.4 SYSTEM DESCRIPTION

A. Provide all labor and materials for a complete raceway system including some or all of the following components:

1. Outlet boxes

2. Conduit

3. Surface raceway and matching boxes

4. Sleeves and approved fireproofing

5. Pullboxes, pullstrings, bushings

6. Backboards

7. Grounding

1.5 CABLE TRAYS

A. Refer to Section 26 05 36: “Cable Trays” for requirements.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Provide 4" welded square boxes for each recessed outlet box. Provide 3½" deep masonry type in recessed masonry installations.

B. Provide single gang mud or tile ring as required for all boxes.

C. Refer to specification Section 26 05 33: "Raceways, Fittings and Boxes" for approved box manufacturers.

2.2 OUTLET DEVICES AND COVERPLATES

A. Outlet devices and coverplates are provided under Section 27 13 00: "Technology Cabling System".

B. Provide blank coverplates meeting the requirements of Section 26 27 26: "Wiring Devices".

2.3 FLOORBOXES

A. Provide floorboxes as described in Section 26 05 50: "Floorboxes and Pokethroughs".

2.4 MISCELLANEOUS

A. Provide plywood terminal boards on all walls of each IDF, MDF, Technology and Data rooms. Plywood to be 3/4" x 8'-0" high and shall be painted with two coats of fire retardant marine grey enamel on both sides. Mount plywood 2" above finished floor, with the 8' dimension in the vertical plane.

B. Provide grounding system per Section 26 05 26: "Grounding and Bonding for Electrical Systems."

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide empty raceway system from each technology outlet box to accessible lay-in ceiling space.

B. Rough-in requirements

1. Accessible ceiling (lay-in grid)
    a. Provide an empty box with (1) 1" conduit stubbed into ceiling space for each telephone outlet indicated on the drawings.
    b. Provide an empty box with (2) 1" conduits stubbed into ceiling space for each voice/data outlet indicated on the drawings.
    c. Provide an empty box with (2) 1" conduits stubbed into ceiling space or each data outlet indicated on the drawings.
    d. Provide an empty box with (2) 1" conduits stubbed into ceiling space for each fiber optic outlet indicated on the drawings.
2. Inaccessible ceilings (plaster, spline, gypsum, security grid, plank, etc.)
    a. Provide an empty box with (1) 1" conduit routed to the nearest telephone backboard location for each telephone outlet, unless noted otherwise on the plans.
    b. Provide an empty box with (2) 1" conduits routed to the nearest communications closet backboard location for each voice/data outlet, unless noted otherwise on the plans.

c. Provide an empty box with (2) 1" conduits routed to the nearest communications closet backboard location for each data outlet, unless noted otherwise on the plans.

d. Provide an empty box with (2) 1" conduits routed to the nearest communications closet backboard location for each fiber optic outlet, unless noted otherwise on the plans.

3. Floorboxes

a. Provide floorboxes with (2) 1" conduits routed in the slab or under the slab to the nearest accessible ceiling space or accessible tunnel space.

C. Provide a minimum of (2) 4" conduit sleeves between floors at each backboard location, unless noted otherwise. Provide a minimum of (4) 2" conduits from each backboard location to the accessible ceiling space in the corridor adjacent to the backboard location, unless noted otherwise.

D. Provide at least one isolated grounding double duplex receptacle wired to a dedicated 120 volt, 20 amp circuit at each backboard location for Owner equipment. Provide a separate hot, neutral and ground conductor. Coordinate with the Owner or designated installer. Refer to the plans for additional information.

E. Fireproof all sleeves with an approved fireproofing sealer to maintain the fire integrity of the slab or wall. Refer to Section 26 01 00: "Common Work Results for Electrical".

F. Bush all conduits. Provide a pullstring in each conduit.

G. Permanently label the ends of each conduit stub with the Architectural room numbers, in order to identify each outlet box for the technology cable installer.

END OF SECTION

SECTION 26 05 35

WIREWAYS

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 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 29: Supporting Devices

C. Metal Wireways (NEC Article 376)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 WIREWAYS

A. Provide "lay-in" type wireway with lengths and connectors hinged to provide unobstructed lay-in of conductors. All fittings must be so constructed to continue the "lay-in" feature through the entire installation.

B. Provide all sheet metal parts with a rust-inhibiting phosphatizing coating and finished in baked enamel. Plate all hardware to prevent corrosion.

C. Provide raintight construction with gasketed cover for all exterior wireways.

D. Provide wireways without knockouts, except for exterior wireway.

E. Provide hinged cover.

F. Provide U.L. label and listing for all lengths, connectors and fittings. Install in accordance with the National Electrical Code and the drawings. U.L. listing of lengths without listing connectors or fittings is not acceptable.

G. Approved manufacturers:

1. Square D "Square-Duct"
2. Hoffman
3. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide wireways only where specifically allowed by the Engineer, and only prior to installation. Wireway is not allowed to be a substitution for conduit, pullboxes or other raceways or conduit bodies. Do not use wireway as an auxiliary gutter above or below panelboards.

B. Install parallel and perpendicular to building lines.

C. Provide all fittings required along the entire route of wireway.

D. Size wireways for a maximum of 20% fill after any ampacity derating factors have been applied to the cables.

E. Provide wireway sufficiently sized to accommodate the cable bending radius requirements for cables.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Refer to individual Division 27 and 28 sections.

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 33 – Raceways, Fitting and Boxes

D. Section 26 22 13 – Transformers

E. Section 26 24 16 – Panelboards

F. Section 26 28 16 – Safety Switches

G. Section 26 29 13 – Motor Control

PART 2 PRODUCTS

2.1 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Minimum 1/8” thick laminated bakelite: White face with black lettering.

B. Engrave characters with a minimum height of 1/4".

C. Minimum plate size: 1” x 3.5”. Provide larger plate if necessary to fit all lettering on it.

D. Approved manufacturers

1. Square D
2. Siemens
3. Cutler Hammer
4. General Electric
5. Pre-approved equal

2.2 SERVICE IDENTIFICATION NAMEPLATES

A. Provide signage per NEC Articles 110.22, 230.2(E) and 230.70(B)

B. Provide nameplates on each main service disconnecting means describing what areas are served by the disconnecting means, and where the other disconnecting means are located.

2.3 EMERGENCY SOURCE IDENTIFICATION NAMPLATES

A. Provide signage per NEC Article 700.8.

B. Provide nameplates near each main service disconnecting means indicating that the building has an on-site generator and where it is located.

2.4 ARC FLASH WARNING SIGNS

A. Provide Arc Flash warning signs on all electrical equipment as required by 2008 NEC 110-16:

"Electrical equipment, such as switchboards, panelboards, industrial control panels,meter socket enclosures, and motor control centers, that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment."

B. Minimum size: 3½"x 5"; B302 polyester or vinyl with laminate overlay.

C. Approved manufacturers

1. Brady
2. Seton
3. Pre-approved

2.5 BOX IDENTIFICATION

A. Approved manufacturers

1. Sharpie
2. Avery Marks-A-Lot
3. Pre-approved equal

2.6 CONDUIT IDENTIFICATION

A. Provide stenciling of conduits located in accessible areas.

B. Provide black epoxy spray paint and 1" high stenciled lettering.

2.7 COVERPLATE IDENTIFICATION

A. Provide ¼" high engraved black-infilled lettering or laser etching when engraved coverplates are specified or noted on the plans.

B. Approved manufacturers

1. Cooper
2. Pass and Seymour
3. Hubbell
4. Leviton
5. pre-approved equal

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with governing regulations and governing authority for identification of electrical work.

3.2 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Provide identification plates on the following electrical equipment:

1. Each panelboard, distribution panel, switchboard, motor control center and switchgear. Provide the following information on each nameplate: panel name, voltage, wire configuration, feeder conduit size, phase wire size, neutral size, ground wire.

Example:

TLP-1-1
208/120V, 3P4W
2”C - 3#2/0, #350 NEUT
#4 GND, THWN

2. Each overcurrent device in distribution panels, switchboards, motor control center and switchgear
3. Transformers
4. Disconnect switches (engrave per the equipment served)
5. Motor starter switches, motor starters, remote motor control stations (engrave per the equipment served)
6. Power factor correction capacitors
7. SPD equipment cabinets
8. Contactor cabinets
9. Lighting control panels

B. Install nameplate parallel to equipment lines.

C. Install nameplates inside covers in finished areas using approved contact cement.

D. Install nameplates outside covers in unfinished areas by mechanical fasteners (screws or rivets).

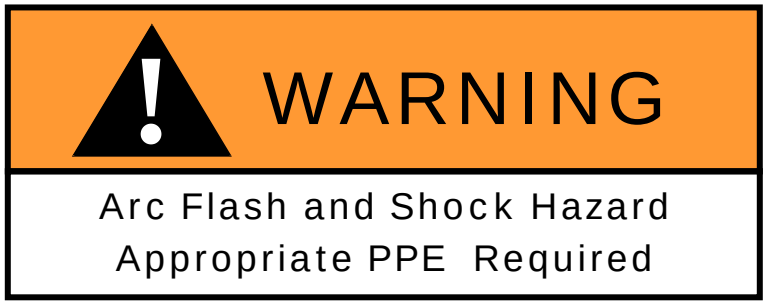
3.3 ARC FLASH WARNING SIGNS

A. Provide signs suitable for the environment in which they are located:

1. Provide engraved plates with the physical specifications called out in paragraph 2.1 above for exterior equipment.
2. Provide laminated, pressure sensitive signs adhered to the outside covers of equipment in unfinished areas.
3. Provide laminated, pressure sensitive signs adhered to the inside covers of equipment in finished areas.

B. Provide signs that indicate that an arc-flash hazard exists at this location, and that proper personnel protective equipment should be worn prior to serviving the equipment.

Example:



3.4 BOX IDENTIFICATION

A. Provide panel and circuit number(s) identification on the cover of all junction boxes and pullboxes located in accessible areas (i.e. above accessible ceilings).

B. Provide clear, hand-printed lettering using black permanent marker.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this specification section. Re-label any boxes that have been painted over by the painter.

3.5 CONDUIT IDENTIFICATION

A. Provide stenciling of conduits and pullboxes of the following:

1. Medium Voltage and High Voltage feeder conduits and pullboxes
2. Panelboard, distribution panel, switchboard, motor control center and switchgear feeder conduits and pullboxes.
3. Service entrance conduits and pullboxes at the point of accessibility for cable TV, Telephone and Fiber Optic cables.
4. Lightning Protection System downlead conduits

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this section.

D. Perform stenciling on 50’ centers, maximum, along entire accessible length of conduits

3.6 COVERPLATE IDENTIFICATION

A. Provide engraving or laser-etching on the plate immediately above the wiring device, unless noted otherwise.

END OF SECTION

SECTION 26 05 60

CONCRETE PADS FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Division 03: Concrete

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 24 13: Switchboards

D. Section 26 24 16: Panelboards

E. Section 26 27 13: Electricity Metering Cabinets

F. Section 26 29 13: Motor Controls

G. Section 26 56 13: Lighting Poles and Standards

PART 2 EQUIPMENT

2.1 UTILITY TRANSFORMER PAD

A. Provide a concrete transformer pad built to Xcel Energy current standards, including the following illustrations found in *Xcel Energy Standard for Electrical Installation and Use*:

1. Drawing CC-10 & CC-10A – Customer Owned Secondary Connection Cabinet
2. Drawing CC-50 & CC-50A – Secondary Connection Cabinet and Transformer Poured-in-Place Pad.
3. Refer to the end of this section for copies of these drawings.

B. If a connection cabinet is included in the project under Section 26 27 13: Electricity Metering Cabinets, provide a continuous pad for both the utility transformer and the connection cabinet.

2.2 EQUIPMENT PADS

A. Provide concrete pads for all floor-mounted equipment, unless already called out to be provided under Division 3, which may include the following equipment:

1. Switchboards
2. Distribution Panelboards
3. Transformers
4. Electricity Metering Cabinets
5. Any other floor-mounted electrical equipment.

PART 3 EXECUTION

3.1 UTILITY TRANSFORMER PAD

A. Provide proper soil correction and preparation as indicated on the Xcel Energy drawings listed in section 2.1 above.

B. Primary Conduits: Provide two (2) 4" conduits with 36" sweep elbows stubbed up into the primary opening of the transformer, and extended out 5 feet from the pad location for utility primary cables.

3.2 EQUIPMENT PADS

A. Provide minimum 4" high concrete pads for all floor mounted equipment.

B. Provide 8" minimum thick concrete pads for engine-generator sets. Coordinate structural requirements of engine-generator pads with the generator manufacturer.

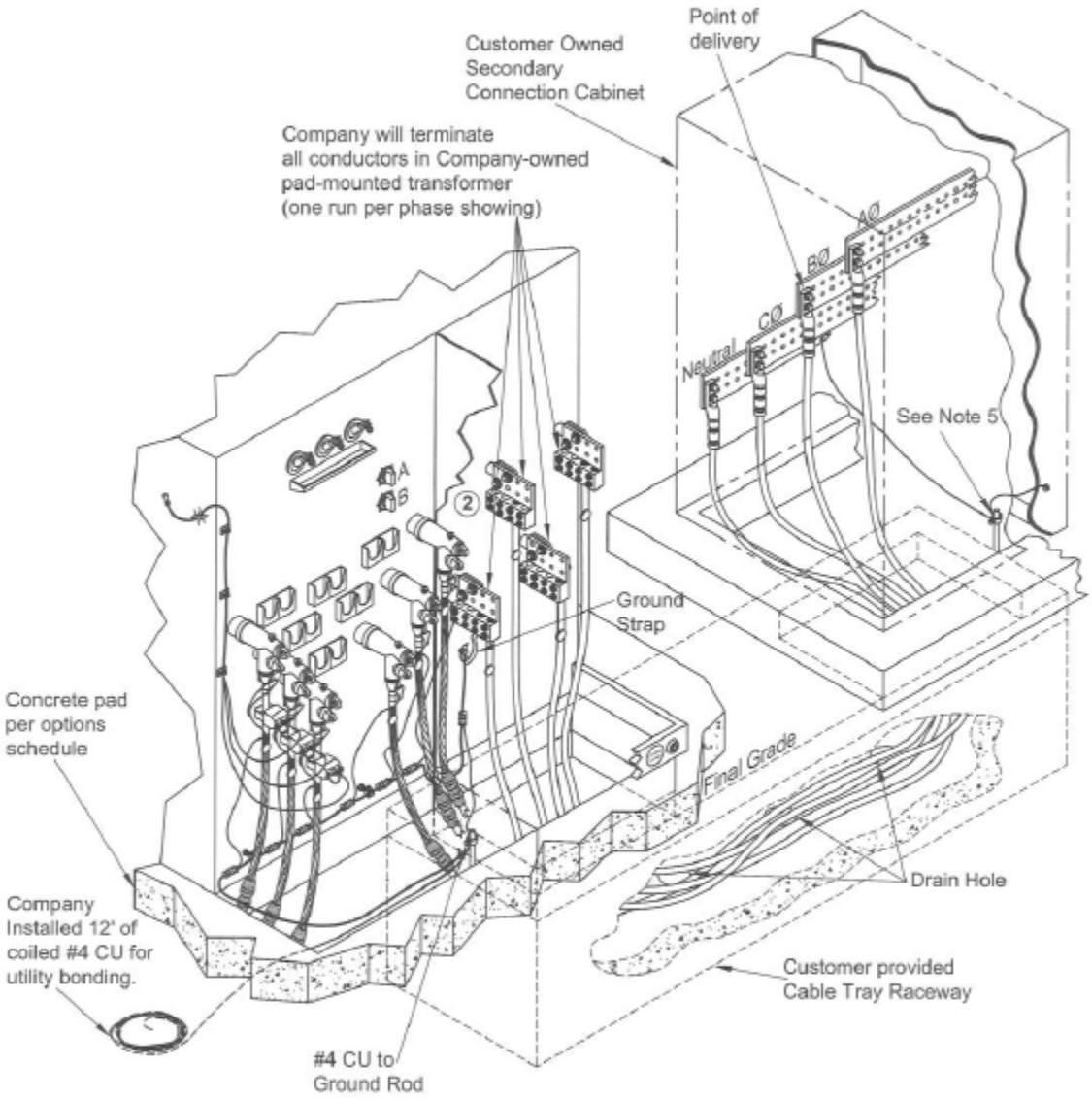
C. Size pad to provide a minimum 2" overlap around perimeter of equipment, including future sections to switchboards.

D. Provide steel reinforcement as required for load or as indicated on the drawings.

3.3 DRAWING CC-10

DRAWING CC-10

CUSTOMER OWNED SECONDARY CONNECTION CABINET (SCC)



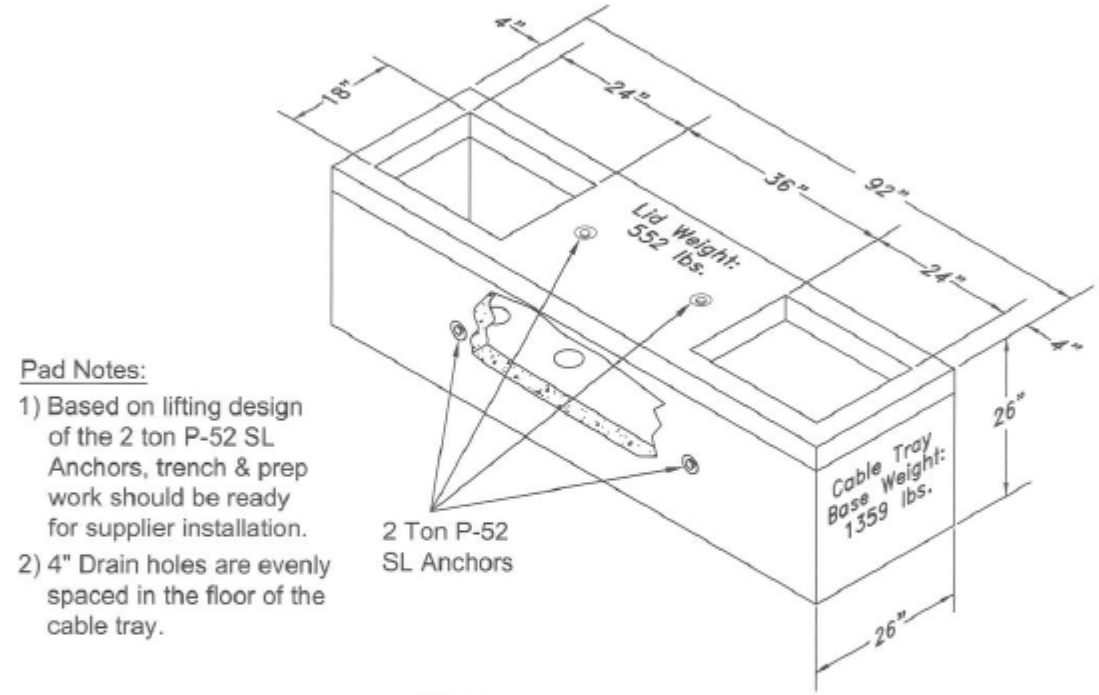
NOTES:

1. Company will furnish and install pad-mounted transformer.
2. Company will furnish and install conductors from transformer secondary connection cabinet including termination lugs at secondary connection cabinet.
3. Customer shall furnish, install and maintain continuous and/or separate pad for transformer and secondary connection cabinet per schedule, page I-6.21 and drawing pages CC-40 through CC-40G.
4. Customer shall furnish, install and maintain secondary connection cabinet and bus bar hole pattern shall have NEMA spacing (1-3/4" on center) and be centered on bar. SCC bus bar holes to accommodate 1/2" bolts
5. Customer to furnish ground rod for bonding to enclosure and at right side of neutral bus bar installed per NEC® .

3.4 DRAWING CC-10A

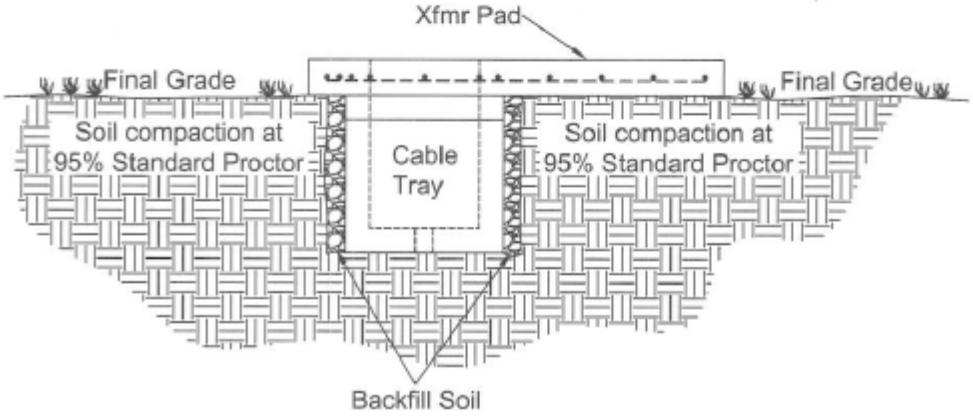
DRAWING CC-10A

SECONDARY CONNECTION CABINET (SCC)
PRE-CAST CABLE TRAY SPECIFICATION



Pad Notes:

1) Based on lifting design of the 2 ton P-52 SL Anchors, trench & prep work should be ready for supplier installation.
2) 4" Drain holes are evenly spaced in the floor of the cable tray.



3.5 DRAWING CC-50

DRAWING CC-50

SECONDARY CONNECTION CABINET AND TRANSFORMER POURED-IN-PLACE PAD

15 & 25 kV for 75-500 kVa

In-Line Orientation-Preferred

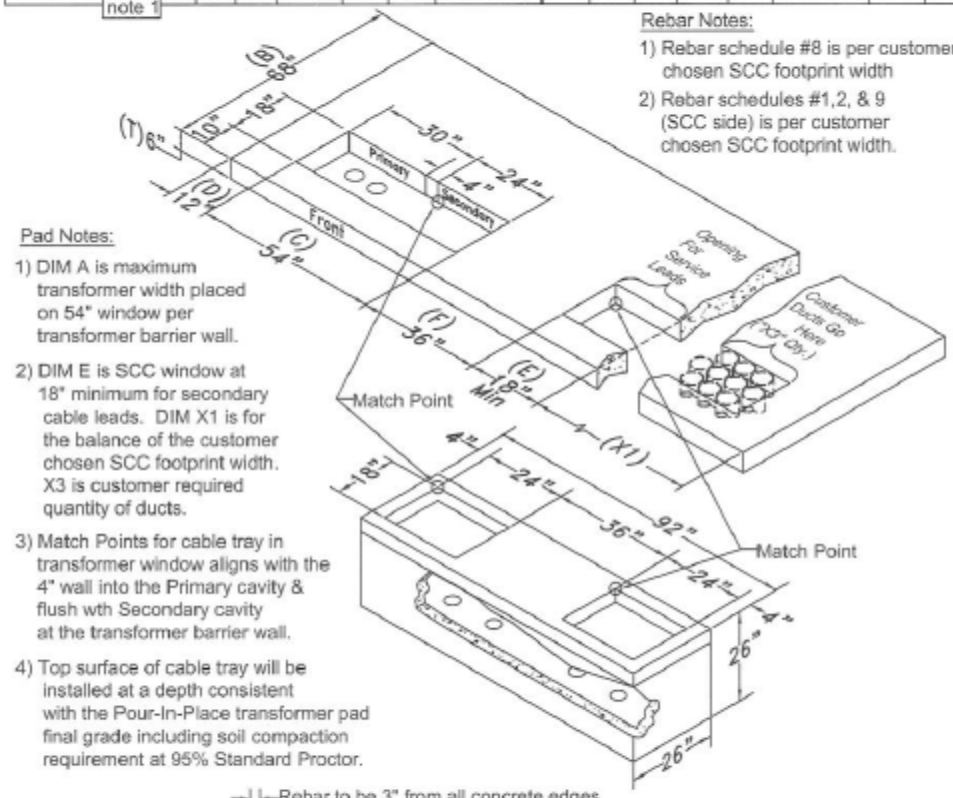
15 & 25 kV 75-500 kVA	PAD DIMENSIONS (DIM)								REINFORCED STEEL SCHEDULE								
	A	B	C	D	E	F	T	X1	①	②	③	④	⑤	⑥	⑦	⑧	⑨
	78" See note 1	68"	54"	12"	18" Min	36"	6"	Bal of SCC width	5-#4	3-#4	3-#4	7-#4	3-#4	2-#4 x 3'0"	14-#4	4-#4	#4

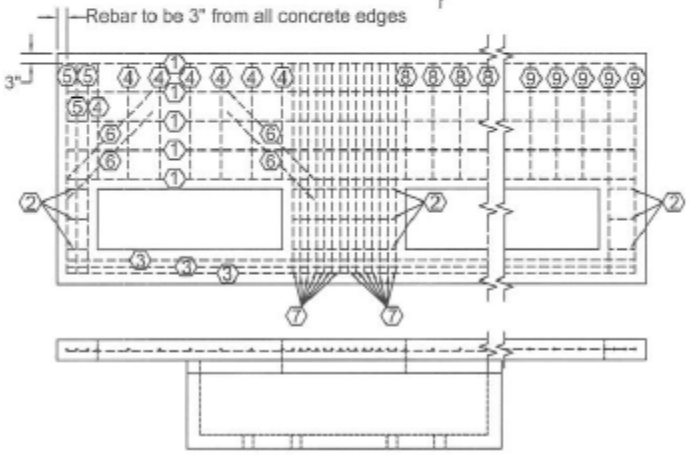
Rebar Notes:

1) Rebar schedule #8 is per customer chosen SCC footprint width
2) Rebar schedules #1,2, & 9 (SCC side) is per customer chosen SCC footprint width.

Pad Notes:

1) DIM A is maximum transformer width placed on 54" window per transformer barrier wall.
2) DIM E is SCC window at 18" minimum for secondary cable leads. DIM X1 is for the balance of the customer chosen SCC footprint width. X3 is customer required quantity of ducts.
3) Match Points for cable tray in transformer window aligns with the 4" wall into the Primary cavity & flush wth Secondary cavity at the transformer barrier wall.
4) Top surface of cable tray will be installed at a depth consistent with the Pour-In-Place transformer pad final grade including soil compaction requirement at 95% Standard Proctor.





3.6 DRAWING CC-50A

DRAWING CC-50A

SECONDARY CONNECTION CABINET AND TRANSFORMER POURED-IN-PLACE PAD

15 & 25 kV for 75-500 kVa

90° Orientation

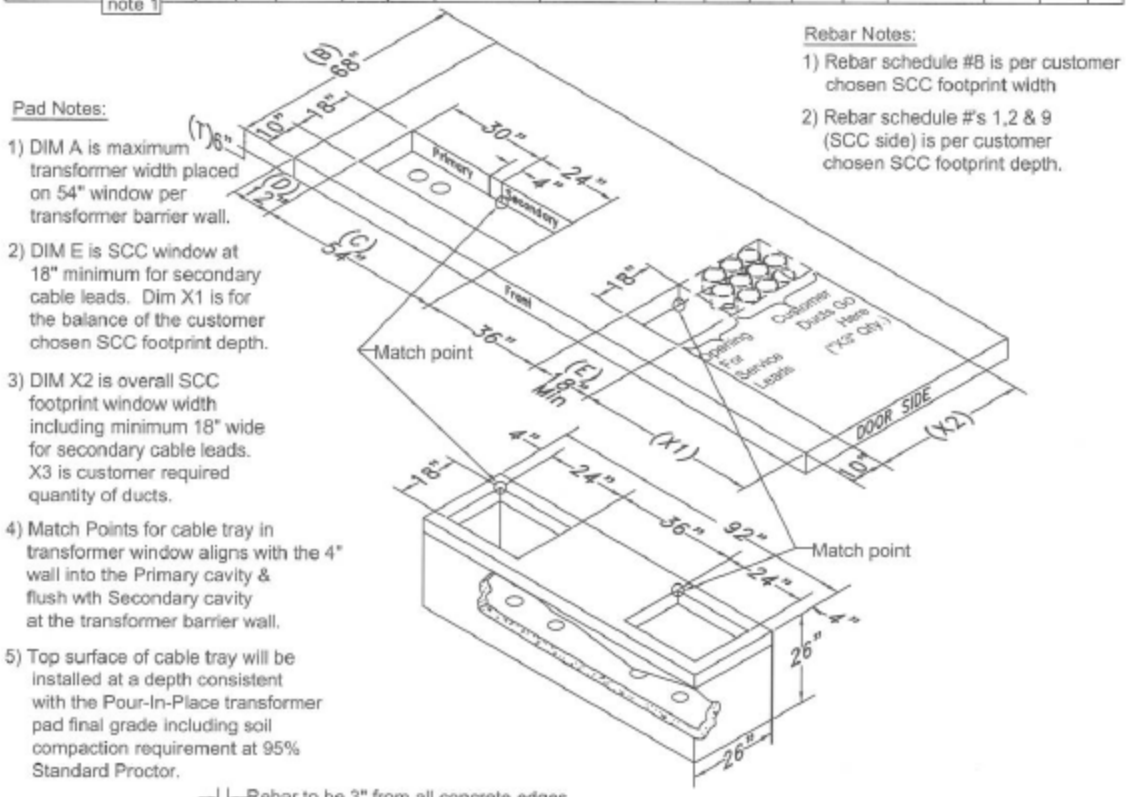
15 & 25 kV 75-500 kVA	PAD DIMENSIONS (DIM)									REINFORCED STEEL SCHEDULE								
	A	B	C	D	E	F	T	X1	X2	①	②	③	④	⑤	⑥	⑦	⑧	⑨
	78" See note 1	68"	54"	12"	18" Min	36"	6"	Bal of SCC depth	Bal of SCC width	5-#4	3-#4	3-#4	7-#4	3-#4	2-#4 x 3'0"	14-#4	4-#4	#4

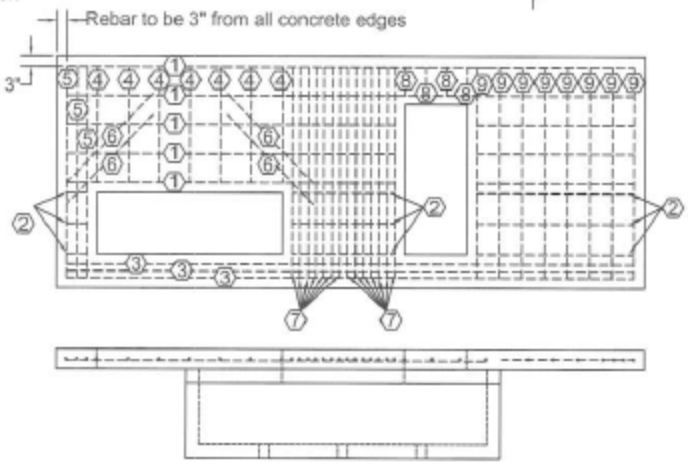
Pad Notes:

1) DIM A is maximum transformer width placed on 54" window per transformer barrier wall.
2) DIM E is SCC window at 18" minimum for secondary cable leads. Dim X1 is for the balance of the customer chosen SCC footprint depth.
3) DIM X2 is overall SCC footprint window width including minimum 18" wide for secondary cable leads. X3 is customer required quantity of ducts.
4) Match Points for cable tray in transformer window aligns with the 4" wall into the Primary cavity & flush wth Secondary cavity at the transformer barrier wall.
5) Top surface of cable tray will be installed at a depth consistent with the Pour-In-Place transformer pad final grade including soil compaction requirement at 95% Standard Proctor.

Rebar Notes:

1) Rebar schedule #8 is per customer chosen SCC footprint width
2) Rebar schedule #'s 1,2 & 9 (SCC side) is per customer chosen SCC footprint depth.





SECTION 26 09 23

OCCUPANCY SENSORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 09 24: Daylight Sensors

D. Section 26 09 43: Lighting Control Equipment

E. Section 26 51 13: Lighting

1.3 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to location and installation.

B. UL Compliance: Provide equipment which is UL listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a complete shop drawing package of the proposed system.

C. Provide clearly legible shop drawings.

D. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

E. Submit rough-in requirements including box sizes, conduits, mounting heights, etc.

F. Submit wiring diagrams indicating all system components and the wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

G. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

H. Submit reproducible floor plans that indicate quantity and locations of power packs and sensors required to provide total coverage. Include orientation of directional sensors where applicable.

I. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list, the quantity and description of all spare parts to be turned over to the Owner at the end of the project. Indicate clearly the locations of additional sensors (if any) recommended by the manufacturer in order to provide adequate coverages (see paragraph 3.1.B below).

J. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

K. Submit physical and schematic drawings of special and custom components or hardware.

L. Submit complete description of system operating sequence.

M. Submit complete mounting details and instructions for all equipment to be installed.

N. Submit complete operating description of the devices. Indicate how to make sensitivity and time delay adjustment to each type of device.

O. Shop drawings not containing all the information listed above will be rejected without review.

1.5 SYSTEM DESCRIPTION

A. Where occupancy sensors are indicated on the plans or specified herein, provide all components, power packs, mounting hardware, brackets, wiring and terminations required to provide on/off control of the light fixtures in the space served by the occupancy sensors.

B. Provide occupancy sensors with sufficient coverage to ensure positive detection of activity from any location within the room or space. Provide additional occupancy sensors than those shown on the plans if required or recommended by the manufacturer to ensure proper coverage of the entire space.

C. Provide the proper type of occupancy sensor based on the type of space, use, and size of the room. The following chart indicates the proper type of occupancy sensor based on typical use spaces. Refer to the plans for specific types and applications.

Type of space	Dual Technology (DT)	Ultrasonic (US)	Passive Infrared (PIR)
Public Restrooms		√	
Stairwells		√	
Corridors		√	
Conference Rooms		√	
Classrooms	√		
Hard Offices		√	
Open Office Areas			√
Work Rooms	√		
Vestibules			√
Adverse environments			√

D. Dual technology occupancy sensors are identified on the plans as type “DT”. Ultrasonic motion sensors are identified on the plans as type “US”. Passive infrared motion sensors are identified on the plans as type “PIR”.

1.6 SYSTEM OPERATION

A. In locations where light switches and occupancy sensors are indicated in the room or space, provide the following operation:

1. If the light switch(es) are in the OFF position, the lights shall remain OFF. Activity in the room shall <u>not</u> energize the lighting.

2. If the light switch (es) are in the ON position, the lights shall be controlled by the occupancy sensor(s). Activity in the room shall energize the lighting. Lack of activity (maintained for a predetermined time period) shall de-energize the lighting.

B. In locations where occupancy sensors are the sole controlling unit in the room or space, provide the following operation:

1. The lights shall be controlled by the occupancy sensor(s). Activity in the room shall energize the lighting. Lack of activity (maintained for a predetermined time period) shall de-energize the lighting.

C. Provide occupancy sensors that fail in the energized state for occupancy sensors controlling egress lighting (i.e. corridors).

D. Provide occupancy sensors with integral Form C relay to allow control of external devices including the following:

1. Thermostats
2. EMS data gathering modules
3. Ceiling fans
4. HVAC equipment such as VAV boxes, unit ventilators and fan coil units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment supplied by manufacturers as listed herein are considered approved for bidding on this project. Where specific models are referred to, the intent is to establish a minimum level of features and performance.

B. Systems manufactured by the following are approved for bidding purposes on this project. Approval for installation is subject to review and approval of shop drawings.

1. Dual Technology Sensors
    a. Ceiling:
        1) Wattstopper DT300 (for 500 sq. ft. rating and 1000 sq. foot rating only)
        2) Wattstopper DT200 (for 2000 sq. ft. rating only)
        3) Leviton OSC (05) (10) (20)-MOW
        4) Hubbell Mytech OMNIDT series
        5) Sensorswitch equal
2. Ultrasonic Sensors
    a. Rooms - Ceiling
        1) Wattstopper WT (600) (1100) (2200)
        2) Leviton OSC (05) (10) (20)-UOW
        3) Hubbell Mytech OMNIUS series
        4) Sensorswitch equal
    b. Corridors - Ceiling

1) Wattstopper WT (2250)
2) Hubbell Mytech approved equal
3) Sensorswitch equal

3. Passive Infrared Sensors
   a. Ceiling
      1) Wattstopper CI-(200) (200-1)
      2) Leviton OSC(04) (15)-IOW
      3) Hubbell Mytech approved equal
      4) Sensorswitch equal

2.2 OCCUPANCY SENSORS - ALL

A. Provide the following specifications for all occupancy sensors

1. Solid state, operates at 24VDC supplied by a power module.
2. Load Ratings: 20 amps fluorescent, 20 amps HID and 13 amps incandescent loads.
3. Optional integral isolated Form C relay rated at 0.5 amp @24VDC.
4. High impact, injection molded plastic housing.
5. Mounting hardware designed for the particular application: wall, ceiling, corner surface, wall switch retrofit, etc.
6. Immune to RFI and EMI.
7. Adjustable time delay (8 minutes to 30 minutes).
8. Adjustable sensitivity.
9. LED activity indicators.
10. Operating temperature: +32°F to +104°F at 5% to 95% non-condensing humidity.
11. UL Listed.
12. 5 year replacement warranty.

2.3 DUAL TECHNOLOGY OCCUPANCY SENSORS (TYPE DT)

A. Provide dual technology occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:

1. Utilizes passive infrared and ultrasonic technologies for detection.
2. Field configurable to allow any combinations of one, either or both technologies to energize, de-energize or maintain ON status.

2.4 ULTRASONIC OCCUPANCY SENSORS (TYPE US)

A. Provide ultrasonic occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:

1. Operates at a minimum frequency of 32kHz

2.5 PASSIVE INFRARED OCCUPANCY SENSORS (TYPE PIR)

A. Provide PIR occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:

1. 360° coverage
2. Dense Fresnel lens

2.6 VANDAL GUARDS

A. Where vandal guards are indicated on the plans, provide heavy duty guard over the entire device, mounted to structure using dedicated tamperproof hardware (torx head with center pin reject).

B. Provide unbreakable polycarbonate guards.

C. Approved manufacturers:

1. Safety Technology International
2. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide complete and operational system including all line voltage wiring, power packs, occupancy sensors, low voltage wiring, conduit, terminations, setup, testing, calibration, etc.

B. Provide occupancy sensor coverage at rooms and spaces shown on the plans. It is the intent of the plans and specifications to show all necessary occupancy sensors; however, because coverages vary from manufacturer to manufacturer and model to model, additional (or fewer) sensors may be required in each space. Coordinate locations and quantities with the manufacturer prior to bidding. **If additional sensors are required, they will be added at no extra cost to the Owner.**

C. Verify the practical location of each occupancy sensor prior to rough-in. Locations or applications that obviously will not provide the intended coverage or that have obstructions should be brought to the attention of the Engineer immediately. Changes required after the occupancy sensors are installed because of obstacles or other detrimental conditions that were obvious when the sensor was installed shall be done at no cost to the Owner.

D. Connect the power pack(s) on the line side of any local switches serving the controlled lighting. Locate the required power packs above the ceiling in the room served by the sensor(s), or in an adjacent space away from the finished area. Maintain accessibility to the power pack(s) as required by the NEC.

E. Mount ultrasonic detectors away from HVAC diffusers and away from doors leading out of the space.

F. Mount PIR sensors at “line of sight” locations to maximize probability of detection.

G. Install and wire all equipment in accordance with this specification, project drawings and shop drawings.

H. Provide all wiring, conduit, junction boxes and outlet boxes required for the system, including terminations to devices furnished by others.

I. Install all wiring in concealed conduit in new construction. Provide surface raceway and boxes in finished areas of existing construction. Reuse existing conduit and boxes wherever possible.

J. Provide color coded wiring throughout. Test all wiring for opens, shorts and grounds before system startup.

3.2 TESTS AND ADJUSTMENTS

A. Refer to Section 26 01 20: Testing and Adjustments to Electrical Systems

3.3 TRAINING

A. Provide a minimum of two (2) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.4 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer, to the Owner's representative(s).

B. Verify the following before scheduling the system demonstration:

1. The installation is complete.
2. The installation is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.5 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of **one (1) year**. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period. Provide a **five (5) year** replacement warranty on occupancy sensors and power packs.

3.6 SPARE PARTS

A. Provide the following spare parts:

1. Provide five (5) dual technology 1000 square foot rated occupancy sensors
2. Provide five (5) power packs.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Switchboards and Panelboards (NEC Article 408)

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 05 26: Grounding and Bonding for Electrical Systems

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fittings, and Boxes

F. Section 26 05 53: Identification for Electrical Systems

G. Section 26 05 60: Concrete Pads for Electrical Equipment

H. Section 26 24 16: Panelboards

I. Section 26 27 13: Electricity Metering Cabinets

J. Section 26 28 13: Low Voltage Fuses

K. Section 26 43 13: Surge Protection Devices

L. Comply with Nema PB2, NFPA 70 and UL 891.

1.3 SUBMITTALS

A. Provide switchboards and panelboards from the same manufacturer.

B. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Submit "time-current data" with shop drawings for main switchboard overcurrent device, all distribution fuses, and all ground-fault interrupters. Proper trip settings will be indicated on the shop drawings during review. Adjust "trip settings" as indicated by the Engineer.

D. Submit shop drawings of the utility metering provisions to the Utility Company for approval prior to submittal to the Architect/Engineer.

PART 2 EQUIPMENT

2.1 SERVICE ENTRANCE EQUIPMENT – CIRCUIT BREAKER TYPE MAIN

A. Provide a 208/120 volt, 3 phase, 4 wire switchboard with bolt-on tin-plated aluminum bus bars braced to withstand a 100,000 ampere RMS symmetrical fault.

B. Provide 100%-rated main service disconnect switch.

C. Provide service section containing the following:

1. A main disconnect switch consisting of a stationary mounted, electronic trip circuit breaker, with LSIG trip settings and a minimum UL listed interrupting rating of 85,000 RMS symmetrical pickup. Provide main device with Arc Energy Reduction Device as required by National Electric Code.
2. Provide switchboards, panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.
3. Utility metering equipment (see "UTILITY METERING" paragraph below).

D. Distribution Sections

1. Provide separate distribution section(s) with full height bussing and suitable for mounting 3 pole, molded case circuit breakers. Provide full bussing for all space so that no additional work will be required to add devices or sections in the future.
2. Cricuit Breakers
   a. Electrical circuits shall be protected by molded case circuit breakers. Each pole of these breakers shall provide inverse time delay and instantaneous circuit protection by means of a thermal magnetic element on each pole.
   b. The breakers shall be operated by a toggle type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free from the handle so that the contact cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positons. All latch surfaces shall be grounded and polished. All poles shall be so constructed that they open, close and trip simultaneously.
   c. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their cover sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of high pressure butt type and shall be of non-welding silver alloy. Arc extinction must accomplished by means of DE-ION arc chutes, consisting of metal grids mounted in an insulating support.
   d. All load conductor terminals must be listed for use with copper of aluminum conductors rated 90^0F. All terminals must be the box lug or clamp-type design. Screw-head terminals are not acceptable for conductor terminals.
   e. All breaker frame sizes, 600 amps and larger, shall be equipped with solid state trip units that are insensitive to changes in ambient temperature. Breakers are to be furnished with rating plugs that permit changing of the breakers cover. Where shown on the drawings, breakers are to be furnished with adjustable rating plugs with setting as shown to provide maximum overload protection and coordination. The ratings plugs are to be interlocked to prevent interchangeability between breaker frame sizes.
   f. Circuit breakers are to be supplied with short time delay to provide system selectivity. The short time delay is to be adjustable from instantaneous to 10 cycles using one control that simultaneously adjusts each phase's magnetic pick-up and time delay.
   g. 2000 ampere and larger frame sizes shall be available for application of 100% of frame rating per NEC exception when installed in a properly listed enclosure.

h. Circuit breakers shall be listed with Underwriters' Laboratories Inc. (UL 489), conform to the applicable requirements of NEMA Standards Publication No. AB-1-1975, and meet the appropriate classifications of Federal Specifications W-C-375a.

i. Line side terminals shall be bolted to switchboard bus.

j. Circuit breaker ratings, modifications, etc. shall be as indicated on the drawings.

3. Mount all of the above components as shown on the Drawings in a UL approved and labeled, NEMA Class 1 floor mounted steel cabinet constructed of finished steel cleaned, primed, and painted with a baked enamel finish prior to shipment to the job site.

4. Busing

a. Provide non-tapered, 100% rated horizontal busing for all sections.

b. Provide 100% rated neutral bus.

c. Provide a 50% ground bus running full length of the switchboard and ground all non-current carrying parts of the switchboard to this ground bus.

E. Acceptable manufacturers

1. General Electric
2. Siemens
3. Square D
4. EMI
5. AMP (American Midwest Power)
6. States Electric
7. Pre-approved equal.

2.2 UTILITY METERING

A. Provide a metering compartment within the main switchboard service section containing only the Utility Company's instrument transformers with approved means of locking and sealing.

B. Install the current transformers furnished by the Utility Company. Make line and load side connections to the current transformers with removable bolted links to the switchboard bussing.

C. Locate meters per the Utility requirements.

D. Refer to Section 26 27 13: "Electricity Metering Cabinets" for metering requirements if metering is located at connection cabinet, remote from the service switchboard.

PART 3 EXECUTION

3.1 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT

A. Provide service entrance equipment in accordance with the rules and regulations of the Power Company. Electrical energy will be received as indicated on the drawings.

B. Transformer and primary provided by the Utility.

C. Provide transformer pad per Utility requirements. Refer to Section 26 05 60: "Concrete Pads for Electrical Equipment".

D. Verify that the neutral to ground bond is in place at the service entrance equipment prior to energizing.

3.2 SERVICE CONDUCTORS

A. Provide the service feeder, wire in conduit, from the transformer or cable termination cabinet to the main distribution switchboard.

B. Provide Type XHHW or THWN service conductors.

C. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes” for approved raceway system for underground service entrance conductors.

3.3 GROUNDING

A. Provide grounding per Section 26 05 26: “Grounding and Bonding for Electrical Systems”.

3.4 IDENTIFICATION

A. Provide identification nameplates on all switchboards, and on each overcurrent device in the switchboard per Section 26 05 53: “Identification for Electrical Systems”

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Switchboards and Panelboards (NEC Article 408)

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 05 26: Grounding and Bonding for Electrical Systems

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fittings, and Boxes

F. Section 26 05 53: Identification for Electrical Systems

G. Section 26 05 60: Concrete Pads for Electrical Equipment

H. Section 26 24 13: Switchboards

I. Section 26 43 13: Surge Protective Devices

1.3 SUBMITTALS

A. Provide switchboards and panelboards from the same manufacturer.

B. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Submit "time-current data" with shop drawings for all distribution panel overcurrent devices.

PART 2 EQUIPMENT

2.1 DISTRIBUTION PANELBOARDS

A. Provide distribution panelboard assemblies adhering to the following specifications:

1. Compliant to Article 408 of the NEC: “Switchboards and Panelboards”.
2. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks and adjustable trim clamps. Provide NEMA 3R enclosures for exterior locations.
3. Provide 90” high enclosure with full busing where “full height” panels are indicated on the plans.
4. Provide welded metal frame with typed circuit directory for each panel.
5. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C
6. Provide panelboards with interrupting ratings as shown on the plans. Provide switchboards, panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.

7. Provide 600 volt rated panelboards.
8. Provide sub feed or feed through lugs as indicated on the plans.
9. Provide tin-plated copper bus bars or tin plated aluminum bus bars.
10. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
11. Provide all panels by the same manufacturer.
12. Circuit Breaker Distribution Family:
    a. Provide molded case, non-adjustable, thermal-magnetic, quick-make, quick-break, bolt-on type circuit breakers. Refer to the schedules on the plans for sizes and quantities.
    b. Compliant to the following standards: UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1 and BS 4752.
    c. Series rating of circuit breakers is not allowed.
    d. Acceptable Manufacturers:
        1) Square D type I-Line series
        2) Siemens type P4 and P5 series
        3) Cutler Hammer Pow-R-Line 4B series
        4) General Electric CCB series
        5) Pre-approved equal

2.2 BRANCH CIRCUIT PANELBOARDS

A. Provide lighting and appliance panelboard assemblies adhering to the following specifications:

1. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks and adjustable trim clamps. Provide NEMA 3R enclosures for exterior locations.
2. Provide welded metal frame with plastic-covered typed circuit directory for each panel. Directory card must be removeable to allow updating off-site if necessary. Permanently adhered panel directories are not allowed.
3. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C , UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1 and BS 4752.
4. Provide panelboards with interrupting ratings as shown on the plans. Provide panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.
5. Provide 240 volt AC rated panelboards for 208/120 and 240 volt AC systems. Provide 480/277 volt rated panelboards for 480/277 volt systems.
6. Provide double main or feed through lugs as indicated on the plans.
7. Provide tin-plated copper bus bars or tin-plated aluminum bus bars.
8. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
9. Provide all panels by the same manufacturer.

10. Provide molded case, non-adjustable, thermal-magnetic, quick-make, quick-break, bolt-on type circuit breakers. Refer to the schedules on the plans for sizes and quantities.
11. Provide muli-pole breakers where indicated on the schedules. Handle ties on single pole breakers are not acceptable.
12. Tandem breakers are not allowed.
13. Provide circuit breakers with engraved ratings on the handle that are visible without removing the panel cover.
14. Series rating of circuit breakers is not allowed.

B. Acceptable Manufacturers:

1. 240 Volt
    a. Square D type NQOD or NF
    b. Siemens type P1 series
    c. Cutler Hammer Pow-R-line 1a series
    d. General Electric AQ series
    e. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Distribution Panelboards

1. Mount panels and cabinets to building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.
2. Provide 1" empty conduits from each flush mounted panel. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide two (2) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
3. Provide concrete pads under all floor-mounted or free-standing distribution panelboard per Section 26 05 60: “Concrete Pads for Electrical Equipment”.

B. Branch Circuit Panelboards

1. Mount panelboards and cabinets to building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.
2. Mount panelboards with topmost overcurrent device no higher than allowed by the NEC (6’-7”) above finished floor.
3. Provide 3/4" empty conduits from each flush mounted panelboard. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide two (2) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
4. Provide each circuit in the panel(s) with a circuit number securely fastened to the breaker for identification purposes.

5. Provide a circuit directory completely typed on the interior of each panel door.

3.2 GROUNDING

A. Provide grounding per Section 26 05 26: “Grounding and Bonding for Electrical Systems”.

3.3 IDENTIFICATION

A. Provide typed circuit directories in the inside cover of all panelboards and distribution panels.

B. Provide identification nameplates on all panelboards and distribution panels, and on each overcurrent device (including spares) in distribution panelboards per Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

SECTION 26 27 13

ELECTRICITY METERING CABINETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 33: Raceways, Fittings, and Boxes

C. Section 26 05 60: Concrete Pads for Electrical Equipment

D. Section 26 24 13: Switchboards

E. Section 26 28 13: Low Voltage Fuses

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of meters and auxiliaries whose products have been in satisfactory use.

B. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of meters.

C. UL Compliance: Provide meters and components which are UL listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit shop drawings of the connection cabinet meters/sockets/enclosures to Utility for approval prior to submittal to the Engineer. Include data substantiating that units comply with utility requirements.

PART 2 EQUIPMENT

2.1 CABLE TERMINATION CABINET

A. Provide UL listed cabinet that meets Utility requirements.

B. Provide fully-assembled, free standing, NEMA type 3R cabinet. Provide minimum 12 gauge (min.) galvanized steel structure with 14 gauge (min.) panels.

C. Provide 3-point latch, padlock hasps and wind stops on doors.

D. Paint the enclosure transformer green.

E. Provide 600 volt rating, 3 phase 4 wire.

F. Provide electrical grade aluminum (max. 750 A/sq.in.) or copper (max 1000 A/sq.in.) busing. Support bus bars on plastic insulators with provisions for utility current transformers.

G. Provide lugs in sufficient quantity and size to terminate all conductors. Provide 75 degree C rated lugs, minimum.

H. Size cabinet for the service entrance conductors. Provide minimum short circuit withstand rating of 85,000 amperes RMS without cable lashing required.

I. Provide busing with at least the same ampacity as the main switchboard if not specifically sized otherwise on the plans.

J. Provide a metering compartment containing only Utility's current transformers with approved means of locking and sealing.

K. Locate meters per Utility requirements, following the recommended clearance requirements from Utility.

L. Acceptable Manufacturers

1. EMI
2. States Electric
3. American Midwest Power
4. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT

A. The service is to be installed in strict accordance with the rules and regulations of the Power Company. The Electrical Contractor is responsible for all negotiations with the Power Company with regard to the service connections, and shall initiate the necessary request to the Power Company for the work which will be performed by the Power Company.

B. The Electrical Contractor is to pay all fees and charges submitted by the Power Company for their part of the service installation and connections. Provide all work required by the Power Company to facilitate the complete installation of the services. No extras will be allowed because of the failure of the Electrical Contractor to contact the Power Company and determine what will be required by the Contractor in order to complete the service installation.

3.2 CABLE TERMINATION CABINET

A. Install on same contiguous concrete pad as the utility transformer. Refer to Section 26 05 60: "Concrete Pads for Electrical Equipment"

B. Provide raceway between transformer and connection cabinet per the Utility company requirements.

C. Terminate secondary service entrance conductors.

D. Install the current transformers (furnished by Utility). Make line and load side bolted connections of the current transformers at the removable bolted links on the bussing.

E. Provide 3/4" (minimum) conduit from connection cabinet to meter location(s). Provide conductors between CT's and meters.

F. Provide and make terminations to the service entrance conductors on the load side of the connection cabinet busing. Refer to the Power Riser Diagram for sizes and quantities.

3.3 IDENTIFICATION

A. Provide identification in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 29: Supporting Devices

C. Section 26 05 33: Raceways, Fittings, and Boxes

D. Section 26 05 53: Identification for Electrical Systems

E. Section 26 28 13: Low Voltage Fuses

1.3 DESCRIPTION OF WORK

A. Furnish and install where shown electrical cabinets and enlcosures. The electrical cabinets and enclosure shall contain the electrical equipment, metering, and control equipment as detailed on the drawings.

B. The cabinet shall be fabricated and assembled as complete units, complete with all components in place and internally prewired with terminals and terminal strips provided for connections to be made in the field.

C. Refer to other Division 26 sections for cable, wire, connectors, electrical raceway work, motor starters and supervisory control required in conjunction with electrical cabinets and enclosures.

1.4 QUALITY ASSUSANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical cabinets and enclosures of types, ratings and characteristics required, whose products have been in satisfactory use.

B. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of electrical cabinets and enclosures.

C. UL Compliance: Provide equipment and components which are UL listed and labeled.

D. NEMA and ANSI Compliance: Comply with applicable requirement so NEMA and ANSI standards as referred herein.

1.5 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Product Data: Submit manufacturer’s data including specifications, installation instructions and general recommendations for each type of cabinet required. Include data substantiating that units comply with requirements.

PART 2 EQUIPMENT

2.1 EQUIPMENT RACKS AND ENCLOSURES

A. Sound System racks and enclosures – Refer to Division 27 for specifications.

B. Technology equipment racks – Refer to Division 27 for specifications.

C. Video Equipment racks – Refer to Division 27 for specifications.

2.2 TELEPHONE CABINETS

A. Provide recessed phone cabinets that adhere to the following minimum specifications:

1. 16 gauge (min.) housing and door.
2. Continuous recessed LH hinge.
3. Clear polycarbonate (0.188" min. thickness) insert with 1" high letters stenciled "Emergency Phone"
4. Recessed handle
5. Minimum dimensions: 12" wide x 12" high x 7" deep
6. Provisions for ¾" knockouts on top, sides or back of box for routing low voltage cabling and mounting of 2-post telephone outlet.
7. Grounding lug.

B. Approved manufacturers:

1. EMI
2. Hoffman
3. Pre-approved equal

2.3 SWITCH CABINETS

A. Provide recessed switch cabinets that adhere to the following minimum specifications:

1. Sized to accommodate toggle switches for gym lighting control, key switches for backboard motor control, toggle switches for scoreboard power, key switches for gym curtain control and future space for additional switches if called out on the plans.
2. 14 gauge (min.) housing and 12 gauge (min.) door.
3. Interior hinged panel to allow access to all switch wiring and to mount devices.
4. Provide a minimum of two horizontal stiffener reinforcing members on the door and internal hinged panel.
5. Continuous recessed LH hinge.
6. Provide painted cover to match surrounding finish.
7. Recessed "T" handle with single point latch.
8. Minimum dimensions: 24" wide x 16" high x 6" deep
9. Provisions for ¾" knockouts on top, sides or back of box for conduit connections.
10. Provide mechanically-fastened, engraved nameplates under each switch.
11. Grounding lug.

B. Approved manufacturers:

1. EMI
2. Hoffman

3. Pre-approved equal

2.4 PULLBOXES

A. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes” for pullbox requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical cabinets and enclosures as indicated, in accordance with equipment manufacturer’s written instructions, and with recognized industry practices.

B. Coordinate with other electrical work including, wiring and raceway work, as necessary to properly interface installation of electrical cabinets and enclosures.

C. Verify mounting heights for cabinets installed in finished areas with Architect prior to installation.

D. Provide recessed cabinets in areas of finished construction.

E. Touch-up scratched or marred surfaces to match original finishes.

F. Grounding: Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground.

G. Flush-mount telephone boxes no higher than 50” above finished floor to center of cabinet.

H. Mount spare fuse cabinet(s) on wall adjacent to the main distribution switchboard or as indicated on the plans.

3.2 IDENTIFICAITON

A. Equipment/System Identification: Provide equipment/system identification nameplates complying with Section 26 05 50: Electrical Identification.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 26: Grounding and Bonding for Electrical Systems

C. Section 26 05 33: Raceways, Fittings, and Boxes

D. Section 26 27 19: Multi Outlet Assemblies

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 WIRING DEVICES

A. Provide new wiring devices in each outlet indicated on the drawings.

B. Provide devices from one manufacturer.

C. Provide white wiring devices for receptacles connected to normal utility power.

D. Provide toggle white switches that adhere to the following specifications:

1. Federal Specification WS896-E.
2. Rated for 20 amperes, 120-277 volts unless noted otherwise.
3. NEMA WD1 standards.
4. UL listed.
5. Side and back wiring options.

E. Provide momentary contact white switch that adher to the following specification:

- Heavy duty toggle
- Low voltage momentary contact
- 3 amp, 24-AC/DC rating
- Design to match convational switches

F. Approved toggle switch manufacturers/model numbers:

Mfr.	20A/120-277V Wall Switches						
	1-pole	1-pole w/Pilot	2-pole	3-way	4-way	Keyed 1-pole	Mom. Contact
Cooper	2221	2221PL	2222	2223	2224	2221L	1995
Hubbell	HBL1221	HBL1221PL	HBL1222	HBL1223	HBL1224	HBL1221L	HBL1557
P&S	PS20AC1	**PS20AC1-RPL**	PS20AC2	PS20AC3	PS20AC4	**PS20AC1-L**	1251
Leviton	1221-2	1221-2PL	1222-2	1223-2	1224-2	1221-2L	1257

G. Provide receptacles that adhere to the following specifications:

1. Federal Specification WC596.
2. UL listed.
3. Side and back wiring options.
4. One piece solid brass ground strap with integral ground, except GFI receptacles.
5. NEMA 5-20R configuration, rated for 20 amperes at 125 volts, unless noted otherwise. Provide special purpose receptacles rated for the equipment used.
6. Provide SPD (Surge Protective Devices) receptacles that adhere to UL 1449 (second edition), UL 498 and ANSI/IEEE 62.41-1991.

H. Approved standard receptacle manufacturers/model numbers:

Mfr.		20A/125V Standard Receptacles					
	Simplex	Duplex	GFI	IG	DUP W/ USB	SPD	Tamper Resistant
Cooper	5361	5362	XGF20	IG5362	TR9345	5362S	TR8300
Hubbell	HBL5261	HBL5362	GFR5352A	IG5362	USB8300GY	HBL5360SA	HBL8300SGA
P&S	5361	5362A	2094	IG6300	TR8300HUS	8300SP	TR63H
Leviton	5361	5362	8899	5362-IG	T5832-HGG	7380	8300-SG

I. Provide specification grade special purpose receptacles as indicated on the plans.

J. Provide combination recessed, 120 volt, 20amp duplex receptacle with (2) high powered USB charging ports (3.6amps). Capability to charge both USB ports and allows the receptacles to be utilitzed at the same time. Grounding, side wired and back wired.

2.2 WALLBOX DIMMERS

A. Provide solid state, slid-type dimmers suitable for mounting behind a standard depth faceplate and for operation on common neutral circuits.

B. Provide sufficient capacity dimmer to accommodate the connected load of the light fixtures controlled by the dimmer. Provide 600 watt minimum size dimmers.

C. Provide power pack where required for loads gerater than 8 amps.

D. Provide dimmers that are compatible with any IEC 60929 annex E compliant LED driver and ballasts.

E. Coordinate dimmer selection with LED driver and ballast manufactuer specification for 0-10V sink currents.

F. Approved Manufacturers:

1. Lutron Nova T-star series
2. Pre-approved equal.

2.3 COVERPLATES

A. Interior Coverplates: Provide new coverplates over all boxes with the following minimum specifications:

1. All finished areas and unfinished areas with recessed boxes: Provide type 302 stainless steel with smooth satin finish.
2. Unfinished areas over surface mounted boxes: Provide raised metal cover to match the surface metal box.
3. Provide appropriate covers over special purpose receptacles.

B. Exterior Coverplates: Provide new 2-gang, "while in use", weatherproof coverplates for outlets and switches as indicated on the Drawings. Provide weatherproof boots for all dropcords as indicated on the Drawings.

1. Weatherproof switch coverplates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing switch; or cast aluminum with lever and weatherproof gasket.
2. Weatherproof receptacle coverplates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing receptacle.
3. Approved manufacturers:
    a. Red Dot 2CKD Series
    b. Leviton 5977-CL series
    c. Pass and Seymour WIU series
    d. Pre-approved equal
4. Weatherproof boots: Yellow rubber, with overlapping design to seal out water and dirt. Rubber boot shall keep weatherproof seal intact when plug is used with wall mounted receptacles.

PART 3 EXECUTION

3.1 WIRING DEVICES

A. Provide new devices for outlets indicated. Provide individual GFI, isolated ground and surge suppression device for each duplex receptacle in ganged outlets.

B. Wire each device by wrapping the conductors around the terminals and torquing the screw terminal tight.

C. Mount all receptacles with the ground lug on the top.

D. Replace receptacles and plates that have been damaged, burned or discolored during construction, prior to Substantial Completion.

E. Install wall plates after all painting has been completed.

F. Mount wall mounted dimmers in separate boxes from switches.

G. Test wiring devices for continuity, proper polarity connections and grounding.

3.2 WALLBOX DIMMERS

A. Provide all devices (dimmers, accessories and wallplate kits), labor and other services necessary for the proper installation of the devices as indicated on the drawings and specified herein.

B. Contactor shall be responsible for derating dimmer capacity if side sections are removed.

C. Provide separate neutral wires in 120/208V installations. Provide control wiring in separate conduit. Comply with manufacturer's restrictions or length of run for control wiring.

D. Devices shall be installed utilizing manufacturers recommended application, wiring and installation instructions.

E. Provide seamless wallplate covers for all devices ganged in a common box. Provide barriers within the box where required by code.

END OF SECTION

SECTION 26 28 13

LOW VOLTAGE FUSES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 24 13: Switchboards

C. Section 26 24 16: Panelboards

D. Section 26 27 16: Electrical Cabinets and Enclosures

E. Section 26 28 16: Safety Switches

F. Section 26 29 13: Motor Control

G. Section 26 29 23: Variable Frequency Drives

H. Section 26 56 13: Lighting Poles and Standards

I. Comply with Nema FU 1 for cartridge fuses.

J. Comply with NFPA 70.

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit "time-current data" with shop drawings for all fuses.

PART 2 EQUIPMENT

2.1 FUSES

A. Provide fuses of the following types (Bussman used as reference):

1. 601 amps and larger: Time-delay type designed to hold 500% of rated current for a minimum of 4 seconds and clear 20 times current in 0.01 seconds or less with interrupting ratings of 200,000 amperes RMS symmetrical and peak let-through current and energy let-through values established by U.L. Standard for Class L fuses. Provide KRP-C fuses.

2. 600 amps and smaller: Dual-Element construction with interrupting rating of 200,000 amperes RMS symmetrical and peak let-thru current established by U.L. Standard for Class RK-1 fuses. Provide LPN-RK/LPS-RK.

3. Motor circuits: Protect all individual motor circuits with full load ampere rating (FLA) of 480 amperes or less with dual-element time-delay fuses. Provide LPN-RK/LPS-RK. Protect larger horsepower motors with time-delay fuses. Provide KRP-C fuses. Provide U.L. Class RK1, dual-element time-delay for all other motors.

4. Motor Controllers: Protect NEMA and IEC style motor controllers with dual-element, time-delay fuses to provide Type 2 coordination for the controller. Provide LPS-RK fuses.

5. Protect circuit breaker panels with U.L. Class RK1, Class L fuses. Provide LPN-RK, LPS-RK, or KRP-C fuses.

B. Class J fuses are not allowed.

C. Acceptable manufacturers:

1. Bussman
2. Ferraz-Shawmut
3. Littelfuse
4. Pre-approved equal.

2.2 IN-LINE FUSEHOLDERS

A. Provide in-line fuseholders with fuses for parking lot light poles, walkway light poles and bollard type light fixtures.

B. Provide dual fuse holders for multi-pole applications

C. Provide load-side breakaway style fuseholders.

D. Provide proper size crimp type connection for load and line side connetions.

E. Provide 200,000 AIC rated Class CC fuses.

F. Approved manufacturers:

1. Ferraz-Shawmut FEC-BA (single pole) & FEY-BA (two pole)
2. Littelfuse LEC-S (single pole) & LEY-S (two pole)
3. Pre-approved equal

PART 3 EXECUTION

2.3 FUSES

A. Provide fuses for all equipment utilizing fused switches or fused safety switches.

B. Verify proper size fuses for all equipment prior to ordering fuses.

END OF SECTION

SECTION 26 28 16

SAFETY SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 14 00 00: Conveying equipment (Elevators)

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 05 33: Raceways, Fittings, and Boxes

D. Section 26 05 53: Identification for Electrical Systems

E. Section 26 28 13: Low Voltage Fuses

F. Section 26 29 13: Motor Control

G. Section 26 29 23: Variable Frequency Drives

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: "Submittals, Closeout Documents, Training and Spare Parts".

B. Submit a table (see Forms at the end of this section), listing all components by equipment tag with the following information indicated:

1. Safety Switch type, size, rating, enclosure type, switches poles, solid poles, HP rating
2. Fuse size and type (if fused)
3. Identification tag/nameplate

PART 2 PRODUCTS

2.1 SAFETY SWITCHES (DISCONNECT SWITCHES)

A. General requirements

1. Provide safety switches as disconnects for all utilization equipment as indicated on the Drawings.
2. Provide lockable handle with multiple hasps to allow proper lockout-tagout procedures.
3. Provide NEMA 3R enclosures when mounted outside. Provide bolt-on hub kit(s) for conduit connections in order to maintain NEMA 3R rating.
4. Provide NEMA 4X non-metallic KRYDON™ switch enclosure for all pool equipment.
5. Unless specifically noted otherwise, provide 3-pole with solid neutral bus for landing line and load side neutral conductors.
6. Provide proper size and quantity of lugs to terminate all phase conductors and neutral conductor. Neutral conductors may require more lugs, and a larger size.
7. Provide interior ground lug.

8. Provide auxiliary contacts in safety switches when used for the following situations:
    a. Elevator disconnect: To allow power to be shut off to the elevator without initiating battery lowering function.
    b. When used in conjunction with VFD's remote from the equipment: To signal the VFD to shut off to avoid voltage spikes.

B. Fused or unfused switch type
1. Provide heavy duty switch with quick-make, quick-break mechanism with positive interlock.
2. Hinged door with mechanical interlock in the ON position, with defeat mechanism.
3. Provide switch with switch mechanism suitable for the type and size fuses specified in Section 26 28 13: "Low Voltage Fuses", whenever fused switches are required.
4. Provide horsepower rated disconnects, fully rated for load-break and load-make operation.
5. Provide service entrance rated switches where required.
6. Provide 200% neutral connection in the switch when serving a SPD grade technology panelboard. Refer to the panelboard summary schedule on the plans, power riser diagram and/or Section 26 43 13: Surge Protective Devices.
7. Approved manufacturers:
    a. Cutler-Hammer DH series
    b. General Electric TH series
    c. Siemens Type VBII series
    d. Square-D Class 3110 series
    e. Allen Bradley 1494 series
    f. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install safety switches with operator handle no higher than 6'-7" above finished floor in front of the safety switch unless otherwise allowed by the NEC.

B. Mount safety switch as close to the equipment as possible. Provide unistrut rack if necessary.

C. Do not mount safety switches on removeable panels on the equipment served. Coordinate location of safety switches with the equipment provider prior to installing the switch.

D. Install safety switches with proper working clearances about the switch.

3.2 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 05 53: "Identification for Electrical Systems" on all safety switches. Label per the name of the device controlled unless noted otherwise on the plans.

3.3 FORMS

A. Fill out the attached form with the information for each safety switch.

END OF SECTION

SAFETY SWITCHES FORM

Tag/ID or Equipment served by Safety Switch	Volts	Ampacity	Fused, Nonfused or Circuit breaker	NEMA Enclosure	Location of Safety Switch (Room #)

SECTION 26 29 13

MOTOR CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 53: Identification for Electrical Systems

C. Section 26 05 60: Concrete Pads for Electrical Equipment

D. Section 26 27 26: Wiring Devices

E. Section 26 28 13: Low Voltage Fuses

F. Section 26 28 16: Safety Switches

G. Section 26 29 23: Variable Frequency Drives

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a table, listing all components by equipment tag with the following information indicated:

1. Starter type and size
2. Disconnect type and size
3. Combination motor starter type and size and if it has a phase failure relay in the enclosure.
4. Control station type and mounting type (surface or flush mounted)
5. Motor starter switch type and mounting type (surface or flush mounted)
6. Phase failure relay.

C. Indicate short circuit current ratings for all equipment.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. All motors will be provided by the Contractor providing the equipment to be driven.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide equipment with a short circuit current rating equal to or larger than the available fault current at the source panel.

2.2 MANUAL STARTER SWITCHES - TYPE MSS

A. Provide "on-off" toggle type manual starter switch with thermal overload protection for single phase motors.

B. Provide each switch with a red pilot light indicating when motor is on.

C. Provide switches located outdoors in a NEMA 4 enclosure and switches located indoors in a NEMA 1 enclosure unless indicated otherwise.

D. Approved Manufacturers (surface mounted):

1. Allen-Bradley bulletin 600 TAX4/TAX5, with pilot light bulletin 600 TAX216/TAX109
2. Square D equivalent
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent

E. Approved manufacturers (flush mounted):

1. Allen-Bradley bulletin 600 TXQ4/TXQ5, with pilot light bulletin 600 TQX216/TQX109
2. Square D equivalent
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent

2.3 MANUAL STARTERS

A. Provide full voltage type starters and thermal overload protection for three phase motors, requiring manual starters, unless indicated otherwise. Provide each switch with a red pilot light indicating when motor is on.

B. Provide starters located indoors in NEMA 1 enclosure, and starters located outdoors in NEMA 3R enclosure unless indicated otherwise.

C. Acceptable Manufacturers for manual starters:

1. Allen-Bradley bulletin 609 series with pilot light
2. Square D equivalent
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent
6. pre-approved equal.

2.4 MAGNETIC STARTERS

A. Provide full voltage type starters and thermal overload protection and external manual reset for all three phase motors, unless indicated otherwise.

B. Provide starters located indoors in NEMA 1 enclosure, and starters located outdoors in NEMA 3R enclosure unless indicated otherwise.

C. Equip each starter with 120 volt coil, control power transformer, secondary fuse block and fuses, 1 set of spare N.O and 1 set of spare N.C. auxiliary contacts, red "ON" pilot light, and "HAND-OFF-AUTO" control switch.

D. Provied additional aux contacts as required to allow power factor correction capacitors to be installed properly without modifications to the starter.

E. Provide phase failure relays for all three-phase motors 3 HP and larger.

F. Acceptable Manufacturers for magnetic starters:

1. Allen-Bradley Bull. 509 &512
2. Square D Class 8536
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent
6. Pre-approved equal.

2.5 COMBINATION MAGNETIC STARTERS

A. Provide unit with fused disconnect and magnetic starter as specified in paragraph 2.3. Provide disconnect with quick make-quick break mechanism and interlock so switch must be in off position before covers can be open. Provide disconnect handle capable of accepting padlocks.

B. Provide phase failure relays for all three-phase motors 3 HP and larger.

C. Acceptable manufacturers: As specified in paragraph 2.3.

2.6 PHASE FAILURE RELAYS

A. Provide motor protection relay that sense phase loss, phase reversal, low voltage and voltage unbalance conditions for all three phase motors three (3) HP and larger.

B. Provide auto-reset with time delay.

C. Provide octal base plug-in type relays.

D. Verify proper voltage for all relays.

E. Approved manufacturers:

1. TimeMark Model #A-258 series
2. Allen Bradley #8135
3. Square D #8430MPS
4. SymCom Model 201A
5. Cutler Hammer / Eaton D65VMLP
6. pre-approved equal.

2.7 CONTROL STATIONS

A. Provide HP rated toggle switches per Section 26 27 26 where toggle switches are called out to control equipment.

B. Provide standard duty control stations in NEMA 1 enclosures, unless indicated otherwise.

C. Provide flush mounted devices and plates in all finished areas.

D. Acceptable manufacturers (surface mounted):

1. Allen Bradley (number indicated for reference)
   a. Momentary start-stop - 800S-2SA.
   b. Maintained start-stop - 800S-2SCM.

c. Momentary start-stop with pilot light - 800S-2SAP.

d. Maintained start-stop with pilot light - 800S-2SBMP.

e. Momentary 3 unit - 800S-3S series.

f. Hand-Off-Auto - 800S-R44SX.

g. Hand-Off-Auto with pilot light - 800-R3SXP.

2. Cutler Hammer equivalents
3. General Electric equivalents
4. Siemens equivalents
5. Square D equivalents
6. Pre-approved equal.

E. Acceptable manufacturers (flush mounted):

1. Allen Bradley (number indicated for reference)

a. Momentary start-stop - 800S-2ASQ.

b. Maintained start-stop - 800S-2BSMQ.

c. Momentary start-stop with pilot light - 800S-2ASPQ.

d. Maintained start-stop with pilot light - 800S-2BSMPQ.

2. Cutler Hammer equivalents
3. General Electric equivalents
4. Siemens equivalents
5. Square D equivalents
6. pre-approved equal.

2.8 DISCONNECTS

A. Provide disconnect switches as specified in Section 26 28 16: Safety Switches.

B. Provide NEMA-3R enclosures for safety switches mounted outside.

C. Provide NEMA 4X non-metallic safety switches when used in exposed unprotected exterior locations, or for pool equipment.

PART 3 EXECUTION

3.1 WIRING

A. Make connections to all motors and power equipment and leave equipment in working order. Check all motors for proper rotation. Tighten connectors and terminals in accordance with manufacturers' recommendations.

B. Coordinate motor location, controls, wiring, etc. with other Divisions as required for proper interface.

C. Make connections to control devices as indicated in the Drawings. Install all control devices in starter covers unless indicated otherwise. For remote mounted control devices and manual starter switches, surface mount devices in unfinished areas and flush mount devices in finished areas.

D. Extend power and/or control wiring for roof mounted equipment to the equipment within the unit curb. Separate roof penetrations are not allowed.

3.2 OVERLOAD PROTECTION

A. Provide properly sized overcurrent and overload protection for each motor called out to have overcurrent and overload protection.

B. Measure the full load current and provide motor overload elements accordingly. Indicate the overload element manufacturer, type, and size of the inside cover of each starter.

C. Submit complete list of "Motor and Starter Installation Data" to the Engineer prior to final completion. Include as a minimum the following information: Motor Name, Motor Location, Starter Location, Starter Type, Starter Manufacturer, Starter Model, Overload Type, Overload Size and Control Station Type and Model.

3.3 PHASE FAILURE RELAYS

A. Install phase failure relays inside the starter enclosure including manual starter enclosures, magnetic motor starter enclosures, motor control center starter tubs, and combination starter/disconnect enclosures.

B. Provide all required control wiring between relay and the starter.

3.4 SAFETY SWITCHES (DISCONNECTS)

A. Provide a lockable disconnect mounted on or adjacent to each motor starter (including VFD's) as required by NEC Article 430.102(A).

B. Provide a lockable disconnect mounted on or adjacent to each motor as required by NEC Article 430.102(B).

3.5 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 05 53: "Identification for Electrical Systems" on all motor starter switches, magnetic starters, combination starters, contactors, disconnects, and control devices. Label per the name of the device controlled unless noted otherwise on the plans. Provide "SPARE" nameplates over spare equipment.

3.6 FORMS

A. Fill out the attached form with the information for each motor control device.

END OF SECTION

MOTOR CONTROL SCHEDULE

Tag/ID or equipment served	Volts	HP	RLA	Starter Type • MSS • FVNR • VFD	Starter Size (NEMA)	Starter Location (Room #)	Combination Starter/Disc?			
							Yes / No	Fused / NF		

SECTION 26 51 13

LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 05 19: 600 Volt Conductors and Cables

D. Section 26 09 21: Contactors

E. Section 26 05 29: Supporting Devices

F. Section 26 05 33: Raceways, Fitting and Boxes

G. Section 26 09 23: Occupancy Sensors

H. Section 26 27 26: Wiring Devices

I. Section 26 52 00: Emergency Lighting

J. Section 26 53 00: Exit Signs

1.3 DEFINITIONS

A. The term 'lighting fixtures' shall be considered the same as Luminaires per the definition Luminaires in the NEC, Article 100-Definitions.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: "Submittals, Closeout Documents, Training and Spare Parts".

B. Submit shop drawings in booklet form with separate sheet for each fixture assembled in alphabetical order by 'type'. Submit manufacturer's data including dimensioned drawings and photometric data prepared by an independent nationally recognized testing lab.

C. Submit shop drawings for each ballast type as specified and/or indicated on the drawings.

D. Additional requirements for indirect linear lighting:

1. Submit scaled plan of each room or areas where the above types are used. Indicate fixture lengths, anchoring locations, feed points, internal wiring diagram of each fixture that shows all switchleg wiring any all low voltage dimming ballast wiring.

2. Identify each light fixture with type and room number used. Provide shipping label that identifies the room number and installation location of each light fixture. Include the plan described above in #1, inside each fixture box shipped to the site.

PART 2 PRODUCTS

2.1 LIGHT FIXTURES

A. Provide fixtures with lamps, ballasts and/or drivers, for each outlet shown on the Drawings and as specified herein. Refer to light fixture schedule on the drawings.

B. Provide U.L. approved fixtures.

C. The type fixtures required are as noted by a capital letter on the Drawings. Contractor is solely responsible for the exact quantities.

D. Provide color stabilized clear virgin acrylic diffusers for interior fixtures. Provide a minimum thickness of 0.156" for troffer lenses.

E. Provide required disconnects at each light fixture as required under the 2014 NEC 410.130(G).

2.2 LED FIXTURES

A. LED fixtures shall be provided as a complete luminaire.

B. Driver

1. The driver's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

C. Housing

1. The electronics/power supply enclosure shall be internal to the luminaire and be accessible per UL requirements.

D. Technical

1. Fixtures shall be tested and rated per most recent edition of IESNA LM-79 and IESNA LM-80, with rated life of 50,000 hours or greater.
2. LED fixture shall be qualified with DLC (Design Lights Consortium).
3. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
4. The operating temperature range shall be 10°F to 104°F.
5. Parameters and tests shall be conducted at different ambient temperatures.
6. Thermal management shall be of sufficient capacity to assure proper operation of the luminaire over the rated life.
7. The maximum junction temperature for the rated life shall not be exceeded at the average operating ambient.
8. The maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.
9. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
10. Power Factor: The luminaire shall have a power factor of 0.90 or greater at all standard operating voltages.
11. THD: Total Harmonic Distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage.

12. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.
    a. The surge protection which may reside within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 for Location Category A-Low. Where failure does not mean a momentary loss of light during the transient event.
    b. Surge protection performance shall be tested per the procedures in ANSI/IEEE C62.45 based on ANSI/IEEE C62.41 definitions for standard and optional waveforms for Location Category A-Low.
13. Operational Performance: The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
14. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
15. Dimming is required. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 5% of rated lumen output. Dimming shall be controlled by a 0-10V signal.
16. Lumen Management (where indicated): The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management/compensation function.
17. Output Color: Minimum CRI 80, and color temperature 3500 D (+/- 100K) unless noted otherwise.
18. Manufacture shall provide a minimum of five year warranty of coverage. Warranty shall include, fixture construction, LED light engine and driver.
19. Energy Star Rated.
20. LED’s shall be manufactured by CREE or PHILLIPS.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide 100 hour initial burn in for fluorescent lamps connected to dimmers or daylight sensors. Refer to Section 26 09 24: “Daylight Sensors”.

B. Provide hangers, rods, mounting brackets, supports, frames, etc. for proper and safe fixture installation. Install fixtures in accordance with manufacturers’ recommendations and instructions. Refer to Section 26 05 29: “Supporting Devices” for approved supporting methods.

C. Provide fixtures complete with all auxiliaries required for proper, safe and distortion free installation in the various ceiling constructions in which they appear. Coordinate ceiling types with the Architectural drawings and provide compatible fixtures.

D. Where master/slave or inboard/outboard switching is indicated, provide tandem-wired ballasts between light fixtures as required by the Minnesota Energy Code.

3.2 CONDUCTORS

A. Wire recessed lay-in fixtures with 6 feet of flexible metal conduit with Type "THHN/THWN" conductors to the outlet box. Provide grounding type connectors for conduit and cable.

B. Provide outlet boxes adjacent to each recessed fixture outlet in suspended ceilings to permit each fixture to be adjusted to fit ceiling pattern and to permit "Feed Through" wiring.

C. Provide conduit for conductors to exterior site fixtures including but not limited to parking lot, walkway, athletic field and/or bollards.

3.3 QUALITY CONTROL

A. At the time of substantial completion, fixtures must be installed and lamped with new lamps. Install fixtures complete with lenses, diffusers, reflectors, louvers and other required accessories. Furnish a minimum of one case of replacement lamps for each type and size lamp used. Deliver replacement stock to the Owner's storage space as directed by the Owner.

B. Replace any damaged reflectors, diffusers, louvers or other components at no expense to the Owner.

C. Clean fixtures free of dust, finger prints, paint, etc..

D. Perform aiming and adjustment of lighting fixtures in accordance with instructions issued by the Engineer. Adjust directional type fixtures (interior and exterior) after dark under the direction of the Architect, Engineer, and/or Owner.

E. Replace defective ballasts within the guarantee period at no cost to the Owner.

END OF SECTION

SECTION 26 52 00

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 05 19: 600 Volt Conductors and Cables

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fitting and Boxes

F. Section 26 51 13: Lighting

G. Section 26 53 00: Exit Signs

H. Emergency Systems (NEC Article 700)

I. Life Safety Code (NFPA 101)

1.3 SHOP DRAWINGS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 UNIT BATTERY EQUIPMENT

A. Provide unit battery equipment that adhere to the following minimum specifications:

1. 120 and 277 volt operation.
2. UL 924 listed.
3. 12 volt, long life, maintenance-free, nickel cadmium type batteries.
4. Batteries sized to illuminate all lamps for 90 minutes.
5. Low voltage battery protection to prevent deep battery discharge during extended outages.
6. Brown out sensing to activate unit when line voltage drops below 80%.
7. Solid state load transfer relay.
8. Integral internal solid state charger.
9. Provide pilot light and test switch. [Self-testing diagnostics]
10. Designed to be wall and/or ceiling mountable.
11. Interior lamps/heads
    a. Thermoplastic heads with fully adjustable swivel, rotation and tilt.

b. Interior lamps: Provide a minimum of 1.0 footcandle along the path of egress at the floor, with units spaced 40'-0" on center at 7'-6" mounting height above finished floor (refer to drawings for actual mounting heights):

1) Twin 8-watt tungsten halogen, sealed beam, PAR36 lamps OR.

2) Twin 5-watt, sealed beam MR-16 lamps.

12. Exterior lamps/heads

a. UL wet label listed.

b. Cast metal or milled housing and cast mounting brackets and boxes.

c. Twin MR-16 flood lamps, 20 watts each, 12 volt operation.

B. Performance

1. Provide emergency lighting to illuminate the egress corridors and other required areas along the or to the path of egress. Refer to the light fixture schedule on the drawings for types.

2. Provide an intensity of not less than 1.0 footcandle at the floor level along the path of egress.

C. Approved manufacturers

1. Refer to the Light Fixture Schedule

2.2 BATTERY PACKS FOR LED FIXTURES

A. Provide battery packs for LED lighting that meets the following minimum requirements:

1. Provide long life, maintenance-free nickel-cadmium batteries.

2. Provide batteries capable of maintaining the required egress illumination for 90 minutes.

3. Low voltage protection to prevent deep battery discharge during extended outages.

4. Brown out protection to activate unit when line voltage drops below 80%.

5. Solid state load transfer relay.

6. Solid state charger.

7. Automatic self-testing.

8. Provide pilot light and test switch visible from below, inside door frame.

B. Verify case size in order to fit inside light fixture housing. Units that do not fit inside the light fixture housing are not acceptable.

C. Approved manufacturer:

1. Bodine. No substitutions. Refer to the Light Fixture Schedule.

2.3 VANDAL GUARDS FOR UNIT BATTERY EQUIPMENT

A. Provide vandal guards where indicated on the plans, that adhere to the following minimum specifications:

1. Separate polycarbonate enclosure, mounts to wall. Shields that mount directly to fixtures are not acceptable.

2. Separate wire guards, mounts to wall. Guards that mount directly to fixtures are not acceptable.

3. Provide guard sized to allow full aiming of heads without binding on the guard.

B. Approved Manufacturers

1. Safety Technology International, Inc.
2. Pre-approved equal

PART 3 EXECUTION

3.1 UNIT BATTERY EQUIPMENT

A. Install a complete and operational emergency lighting system in accordance with NEC article 700 and Chapter 5 of NFPA 101 Life Safety Code.

B. Install equipment as recommended by the Manufacturer. Notify the Engineer of any discrepancies.

C. Support battery units directly from building structural members. Mount units to walls wherever possible.

D. Route raceway down from ceiling to wall mounted devices. Minimize the use of exposed raceway routed through finished spaces.

E. Connect emergency lights to the unswitched lighting branch circuit in the area served by the unit equipment.

F. Install remote emergency lights where indicated. Provide wiring between the remote heads and the battery packs to maintain UL listing of system.

G. Adjust emergency fixture heads for maximum effectiveness or as directed by the Engineer.

3.2 EMERGENCY BATTERY BALLASTS

A. Connect emergency battery ballasts to the unswitched lighting branch circuit in the area served by the unit equipment. Provide handle lock on breaker(s).

3.3 VANDAL GUARDS

A. Securely mount guards to structure using standard hardware with dedicated anchors. Refer to Section 26 05 29: "Supporting Devices".

B. Provide a minimum of four anchors (1 per corner), or additional if recommended by the guard manufacturer.

3.4 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Provide this additional manufacturers warranties:

1. Unit Battery Equipment: Provide 3 year warranty for NiCd battery type units with 5 year pro-rated warranty on NiCd batteries.
2. Emergency Battery Ballasts: Provide 5 year warranty.

END OF SECTION

SECTION 26 53 00

EXIT SIGNS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 05 19: 600 Volt Conductors and Cables

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fitting and Boxes

F. Section 26 51 13: Lighting

G. Section 26 52 00: Emergency Lighting

H. Emergency Systems (NEC Article 700)

I. Life Safety Code (NFPA 101)

1.3 SHOP DRAWINGS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 EXIT SIGNS

A. Provide exit signs that adhere to the following minimum specifications:

1. 120 and 277 volt operation.
2. Multiple LED lamp source.
3. NFPA 101 and EPA/DEP Energy Star Compliant.
4. Green or red stenciled letters (refer to light fixture schedule)
5. Black or white housing (refer to light fixture schedule)
6. Brushed aluminum face (refer to light fixture schedule)
7. Cast aluminum housing, snap together design.
8. Universal mounting: right side (canopy), left side (canopy), top (canopy) and back.
9. Knockouts for chevrons, right and left.
10. Snap-in wiring connections to allow replacement of components without removing housing.

B. For exit signs with battery back-up, provide the following additional minimum specifications:

1. Nickel cadmium batteries sized to provide 2 hours backup.
2. Integral solid state battery charger.

3. Low battery voltage protection
4. Provide pilot light and test switch. [Self-testing diagnostics]
5. AC “ON” indicator
6. UL 924 listed

C. Approved Manufacturers
1. Refer to the light fixture schedule.

2.2 VANDAL GUARDS

A. Provide vandal guards where indicated on the plans, that adhere to the following minimum specifications:
1. Provide polycarbonate enclosure, mounts to wall. Shields that mount directly to exit signs are not acceptable.
2. Provide 9 gauge welded steel mesh wire guards, mounted to wall. Guards that mount directly to exit signs are not acceptable.

B. Approved manufacturers
1. Safety Technology International, Inc.
2. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to installation of exit signs, contact the Building Official and Fire Marshal to arrange a walk-through to discuss exit sign placement, approximately at the mid-point of construction.

B. Provide exit signs at each exit and along the egress path.

C. Mount exit signs to walls wherever possible. Where exit signs are shown to be installed to a lay-in ceiling, provide additional support from the building structure. Refer to Section 26 05 29: Supporting Devices for supporting requirements.

D. Connect exit signs to an unswitched lighting circuit. Circuit can be shared with unit battery equipment provided under Section 26 52 00: Emergency Lighting. Provide handle lock on breaker.

E. Connect exist signs to life safety circuit fed from the emergency generator. Provide handle lock on breaker.

3.2 VANDAL GUARDS

A. Securely mount guards to structure using standard hardware with dedicated anchors. Refer to Section 26 05 29: “Supporting Devices”.

B. Provide a minimum of four anchors (1 per corner), or additional if recommended by the guard manufacturer.

3.3 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Provide these additional manufacturers warranties:

1. Provide a lifetime warranty on exit sign LED's.
2. Provide 5 year warranty on the exit sign unit and electronics.
3. Provide 10 year pro-rated warranty on exit sign batteries

C. Provide lifetime warranty on vandal wire guards

END OF SECTION

SECTION 28 01 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work consists of furnishing labor, materials, equipment and services required for the complete installation of work shown in the Contract Documents and specified in Division 28.
2. Include all parts and labor which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents. Such items include nuts, bolts, anchors, brackets, sleeves, offsets in conduit, fittings, relays, etc.
3. Some equipment and materials provided under Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 26 Contract Documents to determine where these composite crews are required.
4. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.
5. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.
6. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.
7. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

B. Related Sections:

1. Divisions 0 and 1 apply to all work of Division 28 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 28 01 00 takes precedence. Section 28 01 00 specifies conditions, procedures, equipment and material particular to the electrical work and applies to all electrical work of the Contract Documents.
2. Division 0 and 1 and Section 28 01 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 28 work. Copy these documents to all Sub-contractors receiving other Sections of Division 28.
3. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.2 REFERENCES

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

National Electric Code
State and Local Electrical Codes
International Building Code
International Fire Code
International Mechanical Code
State and Local Building Codes and Ordinances
State Industrial Commission Regulations
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State Elevator Code
Occupational Safety and Health Administration Regulations
Americans with Disabilities Act
Uniform Federal Accessibility Standards
State Board of Health
NFPA 101 Life Safety Code
State Energy Code

D. Use the Standard where referenced in the specifications by the following abbreviations:

AIA: American Insurance Association
AIA: American Institute of Architects
ANSI: American National Standards Institute
ASTM: American Society of Testing and Materials
EPA: Environmental Protection Agency
FM: Factory Mutual Insurance Association
IEEE: Institute of Electrical and Electronic Engineers
IES: Illuminating Engineering Society of North America
ICEA: International Cable Engineers Association
NBS: National Bureau of Standards
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
NSC: National Safety Council
UL: Underwriter's Laboratories

1.3 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.

1. The work – as defined in the 2007 AIA Document A201: “The term ‘Work’ means the construction and services required by the Contract Documents whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.”
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.

5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.
7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.
9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. All electrical details and drawings are diagrammatic, unless specifically noted. Field-verify all dimensions and notify the Engineer of any conflicts of discrepancies, in writing, prior to installation.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.
2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Comply with the NEC as applicable to the construction and installation of equipment specified in this section.

E. Provide equipment specified in this section that has been listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

1.5 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.

2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.
2. Install all conduit, cable tray, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.
3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.
4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.
5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.
6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and specifications are complementary and what is called for in either on is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

1.6 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Continuity of existing systems:

1. No Division 28 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.

2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.

3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.

2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.

3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.

B. Excavation and Backfilling:

1. Provide all excavation and backfilling required to complete the installation of the fire alarm system. Conform with the provisions of Division 31 Earthwork of these specifications for all work.

2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Engineer/Architect will inspect the excavation and determine the necessary additional support required.

3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is similar to the above. Remove all large stones, frozen lumps, perishable rubbish and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable or duct. . Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Architect/Engineer reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.

4. Replace all existing surface improvements (i.e.,-street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed by a different Division.

2. Obtain special permission from the Engineer before cutting structural members or finished material.

3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
4. Patch all holes left as a result of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:

1. Refinish all fire alarm equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.
2. Paint all new raceway systems in exposed finished areas to match existing finish.

E. Precast Construction

1. The new construction at the Cafeteria/Gymnasium Area will be constructed by separate Contractor using pre-cast panels.
2. The Electrical Contractor is to incluce in his/her bid all labor, material and other necessary items for the installation of outlet boxes junction boxes, cabinets, conduit, etc. within the pre-cast panels at the manufacturing plant.
3. The Electrical Contractor will furnish and install all items at the pre-cast manufacturing plant as part of the fabrication process.
4. Pre-cast panels are not to be fabricated until the Electrical Contractor has provided written confirmation that all required electrical items have been installed in the pre-cast panels.
5. Prior to fabrication, the Electrical Contractor will provide the Engineer with pre-cast panel shop drawings (elevations) indicating all electrical rough-in locations and mounting heights.

3.3 FIELD QUALITY CONTROL

A. Final Inspection:

1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an inspection and generate a list of items to be corrected or completed before Contract Closeout. If the Engineer is requested to make a final inspection by the Contractor, and the Engineer finds the work is not complete enough to perform that inspection, the Contractor will compensate the Engineer for his time. The Contractor will then perform the necessary work to complete the project and again request a Final Inspection.

3.4 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.5 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

END OF SECTION

SECTION 28 16 13

SECURITY INTRUSION DETECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Security monitoring system

B. Interface to telephone system

1.2 REFERENCES

A. Section 26 01 00: General Provisions - Electrical

1.3 SYSTEM DESCRIPTION

A. Provide a complete operating security monitoring system that includes the following:

1. Main security control panel
2. Keypad located at the administration office as indicated on the plan
3. Interface to telephone system for remote notification of alarm and trouble conditions
4. Remote motion sensors and associated mounting brackets and hardware.
5. Remote glass break sensors and associated mounting brackets and hardware.
6. Remote magnetic door contacts and associated mounting brackets and hardware.
7. Power supplies, standby batteries and charger
8. Supervised signal and power wiring, raceways and terminations
9. Programming, setup, testing, training

B. Provide a system that transmits alarm and trouble signals to a central station, and to a backup location. Systems that cannot transmit a signal to two sites are not acceptable.

1. Transmit an alarm signal if the system detects motion at a remote zone.
2. Transmit and trouble signal if the system detects an open, short or grounded condition of the signal or power wiring for any zone; a battery failure; a power supply failure; or an internal failure.

1.4 SUBMITTALS

A. For general requirements see Section 26 01 00.

B. Submit a complete shop drawing package of the proposed system.

C. Provide clearly legible shop drawings.

D. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

E. Submit reduced scale reproducible sepia floor plans showing all rooms, stairways, corridors, horizontal exits, and all security monitoring components. Include exact wire counts and types, and point address information for each device. Single line for walls may be used.

F. Submit the following riser/wiring/connection diagrams:

1. Single line riser drawing indicating all system components and the vertical wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

2. Functional block diagram showing device wiring, loop communications wiring, power supply wiring, detection device wiring, battery wiring, communications/modem wiring, etc.

3. Branch circuit wiring to the main control panel, sub-panels, and other devices in the system requiring 120 volt power.

G. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

H. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list quantity and description of all spare parts to be turned over to the Owner at the end of the project.

I. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

J. Submit physical and schematic drawings of special and custom components or hardware.

K. Submit power supply sizing and battery sizing calculations showing total security system power draw in the supervisory and alarm conditions.

L. Submit complete description of system operating sequence.

M. Submit complete mounting details and instructions for all equipment to be installed.

N. Shop drawings not containing all the information listed above will be rejected without review.

PART 2 PRODUCTS

2.1 MAIN CONTROL PANEL

A. Provide a main control panel with the following specifications:

1. 12 zones maximum capacity

2. Communications dialer for transmission of alarm and trouble signals to a central station.

3. Supervision of all signal and power wiring for each zone, the batteries and power supplies.

4. Flexibility to configure any input zone as a normally open or normally closed detection device (i.e. door position switches, motion detectors, panic switches, glass break detector, audio threshold alarms, BAS output alarm, etc.)

5. Latching alarm circuits compatible with momentary contact detection devices.

6. Provide Silent Knight Regency 4000, Radionics equivalent or pre-approved equal main control panel.

2.2 STANDBY BATTERIES

A. Provide sufficiently sized batteries to permit normal system monitoring for a continuous period of 24 hours, and transmit an alarm signal through the communications dialer to the central station at the end of the 24 hour period.

B. Provide a battery charger sufficiently sized to fully charge the standby batteries within 8 hours after a complete discharge.

C. Provide maintenance-free sealed gel cell or lead acid batteries.

2.3 DETECTION DEVICES

A. Motion sensors

1. Provide motion sensors with the following specifications:
    a. Dual technology: Passive infrared and ultrasonic detection modes
    b. Powered from the main control panel.
    c. Integral LED for walk-through testing.
    d. Tamper alarm if front cover is removed.
    e. End of line resistor for supervision of wiring
    f. Replaceable lens for different detection coverage requirements.
    g. Adjustable wall or ceiling mounting hardware.
2. Provide motion sensors designed for use in the particular area (i.e. corridors, open area, etc.).
3. Provide C&K 8100S series or Dual Tec motion detectors or pre-approved equal manufacturer.

B. Door contacts

1. Provide recessed magnetic door contacts at each leaf of each monitored door shown on the plans and scheduled herein.
2. Provide concealed wiring throughout. Devices that mount to the exterior of door frames are not acceptable
3. Provide door contacts rated for an air gap of up to 1 ¾”
4. Provide Sentrol 1076C series magnetic door contacts or Senitrol 3005 door bug or approved equal.

C. Glass Break contacts

1. Provide recessed glass break contacts at each leaf of each monitored door shown on the plans and scheduled herein.
2. Provide concealed wiring throughout. Devices that mount to the exterior of door frames are not acceptable
3. Provide contacts rated for an air gap of up to 1 ¾”
4. Provide Sentrol 1076C series magnetic door contacts.
5. Provide intellisense FG-830 flush mounted glass break monitor or approved equal.

2.4 EXTERIOR HORNS

A. Provide and install Ameseco #SSX-51 exterior horn or approved equal.

B. Provide plenum rated cable when allowed in ceiling plenum spaces.

2.5 WIRING

A. Provide wiring types as recommended by the manufacturer.

B. Provide plenum rated cable when allowed in ceiling plenum spaces.

C. Use 22 gauge AWG minimum conductors. Verify maximum wiring distances allowed by the manufacturer.

D. Provide Belden, West Penn, Alpha wire or pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide a complete and fully operational security monitoring system as described herein and as shown on the drawings.

B. Equipment shall be installed and wired in accordance with this specification, project drawings and approved shop drawings.

C. Configure each motion sensor as a unique zone regardless of whether or not there are multiple devices in a specific room or area.

D. Verify the exact location of the detection devices with the Owner and Engineer prior to installation to provide the maximum coverage of the intended area.

E. Install all cable in conduit. Conceal all conduit.

F. Route system wiring in surface mounted wireway in existing areas or in other areas where noted on the plans. Provide conduit sleeves with fireproofing when routing cables through fire rated partitions.

G. Provide supervision of all wiring to all devices. Wire trouble alarm wiring through each device's tamper switch.

H. Coordinate termination of telephone wiring to main control panel with the Owner.

I. Provide all programming, system setup, calibration/aiming and testing.

3.2 TESTS AND ADJUSTMENTS

A. Upon completion of the installation phase, test and adjust the system to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

3.3 TRAINING

A. Provide a minimum of four (4) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.4 AS-BUILT DOCUMENTATION

A. Provide to the Engineer two (2) complete as-built manuals assembled in loose-leaf binders containing the following:

1. As-built system functional block diagrams.

2. Corrected copies of approved shop drawings

3. As-built system wiring diagram.
4. System operation manuals.
5. System maintenance manuals.
6. Name, address and phone number of the responsible service organization.

3.5 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Engineer and to the Owner's representatives.

B. Verify the following before scheduling the system demonstration:

1. System installation is complete.
2. System is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.6 SYSTEM GUARANTEE

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

3.7 MAINTENANCE

A. Maintain a local service organization which is available to perform testing, inspection, repair and maintenance service on the system.

3.8 SPARE PARTS

A. Provide the following spare parts for the system:

1. Two spare motion sensors and mounting hardware
2. One magnetic door contact sets
3. One magnetic door contact sets
4. Three glass break contact sets
5. 5 keys for the main control panel cabinet.

END OF SECTION

SECTION 28 31 00

FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY (EDIT)

A. Fire Alarm System

B. Interface to HVAC Systems

C. Interface to Automatic Closing and Self-Closing devices

D. Interface to Fire Protection System

E. Interface to Owner Telephone system

F. Interface to Elevator Controllers

G. Interface to Elevator smoke hatches

H. Interface to Kitchen Equipment under exhaust hood

I. Interface to Card Access System

J. Interface to Security System

1.3 REFERENCES

A. Section 26 01 00: General Provisions – Electrical.

B. Section 28 01 00: Common Work Results for Electronic Safety and Security

C. Section 28 01 05: Submittals, Closeout Documents, Training and Spare Parts

D. Section 28 01 50: Testing and Fire Alarm Systems

E. Section 26 05 29: Supporting Devices

F. This section is subject to all of the applicable provisions of the above indicated sections.

1.4 UNIT PRICES *(SELECT/DELETE/EDIT)*

A. Provide unit prices for the following items. Include all material, labor, programming, setup and testing required to incorporate the unit as a fully operational addition to the fire alarm system.

1. UNIT PRICE #__: Provide one intelligent photoelectronic smoke detector with addressable base installed in an existing lay-in ceiling, with 50 feet of twisted pair system wiring installed in conduit.

2. UNIT PRICE #__: Provide one intelligent duct smoke detector with addressable base and addressable control module wired to motor starter, installed in an existing accessible HVAC duct, and 50 feet of twisted pair system wiring installed in conduit.

3. UNIT PRICE #__: Provide one horn/strobe unit installed surface mounted to a block wall with surface mounted wireway to accessible ceiling and 50 feet of system wiring installed in conduit above a lay-in ceiling.

1.5 SYSTEM DESCRIPTION

A. Provide a complete operational intelligent addressable fire alarm system including the following components: Main control panel complete with central processing unit, communications cards, initiating loop cards, indicating zone cards, power supplies and backup batteries; remote annunciators with alarm silence and reset capability; remote intelligent detectors; interfaces to HVAC fans, combination smoke/fire dampers and sprinkler systems; audible and visual indicating devices; monitor and control modules; communication devices; raceway system, boxes, wiring, grounding and the associated labor, programming, setup and testing.

B. Provide a multiplexed, fully addressable system whereby all system components communicate with the main control panel for alarm, trouble, supervisory, monitoring and control functions over supervised twisted pair wiring.

1.6 SUBMITTALS

A. For general requirements see Section 26 01 00 and 28 01 00.

B. Submit qualifications of the system installer as specified in this section.

C. Submit a complete shop drawing package of the proposed system.

D. Provide clearly legible shop drawings.

E. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

F. Submit 1/8” scale reproducible sepia floor plans showing all rooms, stairways, corridors, horizontal exits, controlled HVAC units, sprinkler flow and control valves, and all fire alarm system components. The drawings shall include exact wire counts and types, and point address information for each device. Single line for walls may be used.

G. Submit the following riser/wiring/connection diagrams:

1. Single line riser drawing indicating all system components and the vertical wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

2. Functional block diagram showing initiating device wiring, loop communications wiring, annunciator wiring, power supply wiring, indicating device wiring, power supply wiring, battery wiring, communications/modem wiring, etc. It is not necessary to show every initiating and indicating device on the riser diagram, but illustrate the wiring and connection of each type of device on each addressable loop. Indicate on the diagram the quantity of devices on each loop and the maximum allowable quantity of devices on each loop (to determine the number of spare addresses for future expansion).

3. Wiring diagrams showing wiring and terminations between HVAC fan units and the fire alarm system.

4. Wiring diagrams showing wiring and terminations between combination fire/smoke dampers and the fire alarm system.

5. Wiring diagrams showing wiring and terminations between self closing and automatically closing devices and the fire alarm system.

6. Wiring diagrams showing wiring and terminations between sprinkler system flow switches, valve position switches, dry pipe low pressure monitoring switches, etc., and the fire alarm system.
7. (SELECT/DELETE)Wiring diagrams showing wiring and terminations to elevator controllers for primary and secondary recall functions.
8. Branch circuit wiring to the main control panel, sub-panels, and other devices in the system requiring 120 volt power.

H. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

I. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list, the quantity and description of all spare parts to be turned over to the Owner at the end of the project.

J. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

K. Submit physical and schematic drawings of special and custom components or hardware.

L. Submit power supply sizing and battery sizing calculations showing total fire alarm system power draw in the supervisory and alarm conditions.

M. Submit complete description of system operating sequence.

N. Submit voltage drop calculations for indicating devices.

O. Submit complete mounting details and instructions for all equipment to be installed.

P. Submit complete description of system operating sequence.

Q. Shop drawings not containing all the information listed above will be rejected without review.

1.7 QUALITY ASSURANCE

A. Only manufacturers that provide complete engineering, technical and support services to properly complete the project as designed are allowed.

B. Provide the following, prepared by the manufacturer and supplier:

1. Certification of project and drawings.
2. Project management as required by Engineer and Owner.
3. Complete project testing and training to Engineers and Owners satisfaction.
4. Underwriters Laboratories (U.L.) Certification.
5. Service personnel to be NICET Level II Certified.
6. Maintained inventory levels to provide service parts as required by the specification.

C. Provide fire alarm and detection systems conforming to the requirements of the latest edition of the following National Fire Protection Association (NFPA) publications including all amendments to these publications:

1. 13: Standard for the Installation of Sprinkler Systems.
2. 70: National Electrical Code, including Article 760.

3. 71: Protective Signaling Systems.
4. 72: National Fire Alarm Code.
5. 101: Life Safety Code.

D. Construct and install all fire alarm and fire detection equipment in accordance with the following publications:

1. Underwriters Laboratories Inc. (UL): ***(SELECT/EDIT)***
   a. 38 Manually Activated Signaling Boxes for Use with Fire Protection Signaling Systems.
   b. 268 and 268A Smoke Detectors for Fire Protective Signaling Systems.
   c. 346 Waterflow Indicators for Fire Protective Signaling Systems.
   d. 464 Audible Signal Appliances.
   e. 864 Control Units for Fire Protective Signaling Systems.
   f. 1481 Power Supplies for Fire Protective Signaling Systems.
   g. 1971 Visual Signaling Appliances for the Hearing Impaired.
2. Americans with Disabilities Act.
3. International Fire Code (IFC).
4. International Mechanical Code (UMC).
5. International Building Code (IBC).
6. State Building Code
7. State Amendments to the IBC, IMC and IFC.
8. Local (City) Codes

E. Provide components that are listed and cross listed as a product of a single fire alarm system manufacturer by Underwriter's Laboratory, Inc. (U.L.) and bear the "U.L." label. Provide control equipment listed under U.L. category UOJZ as a single control unit.

F. Qualifications of the Installer:

1. Before commencing work, submit data showing that the contractor/subcontractor has successfully installed fire alarm systems of the same type and design as specified. Include the names, locations, and the contact name and telephone number of at least six (6) such installations completed by the installer. Specify type and design for each system and furnish documentation that the system has performed satisfactorily for the preceding eighteen (18) months.
2. Provide evidence of completion of the required manufacturers' training and experience by the contractor or have NICET Level II (or higher), Certified Fire Alarm or Special Hazard Associate Engineering Technician(s), as applicable, in their employ.
3. Installed system to be certified by Underwriter's Laboratories for a period of five (5) years. The system must be covered by a maintenance contract, during this five (5) year term, by a U.L. certified service company. Installing contractor/subcontractor to furnish proof of qualification and listing to perform this service.

4. Experience of Installer: Accomplish installation by a Contractor with a minimum of five years experience in the installation of the specified fire alarm system. Any proposed installer who cannot show evidence of such qualifications will be rejected.

G. Manufacturer's Representative

1. Provide the services of a representative or technician licensed in the State of Minnesota from the manufacturer of the system, or a factory trained technician of the manufacturer of the system, experienced in the installation and operation of the type of system provided. Supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. Provide the required instruction to the Owner's personnel in the system operation, maintenance and programming.

1.8 ZONING

A. Initiating zones

1. Provide one initiating zone for each initiating device.
2. Provide a fire alarm control panel that supports at least 1000 automatic intelligent detectors. Provide loading of each loop card adhering to the following specifications:
   a. Load each loop card with the equal quantity of initiating points (e.g. if three loop cards are required for the system, load each loop card with 33% of the total number of system points, and homerun back to the main panel with the loop wiring).
   b. Load each loop card to a maximum of 80% of the total number of initiating points possible for the loop card.

B. Indicating zones

1. Provide one indicating zone for the interior indicating devices, and one indicating zone for the exterior sprinkler waterflow indicating device.
2. Provide 25% spare capacity on each interior indicating circuit for future indicating devices.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment supplied by manufacturers as listed herein are considered approved for bidding on this project. Where specific models are referred to, the intent is to establish a minimum level of features and performance.

B. Systems manufactured by the following are approved for bidding purposes on this project. Approval for installation is subject to review and approval of shop drawings.

1. GE / Edwards System Technology EST-3 series
2. Gamewell 650 series
3. Notifier Onyx 3030 series (SELECT/EDIT) for 1000 points
4. Notifier Onyx 512 series (SELECT/EDIT) for 500 points
5. Siemens MXL series
6. Simplex 4100ES series (SELECT EDIT) for 512 points for more)
7. Simplex 4020xxx series (SELECT EDIT) for less than 512 points
8. Pre-approved equal

2.2 MAIN CONTROL PANEL

A. Provide a microprocessor-based main control panel with the following features and modules:

1. Communications module for controlling and monitoring all input, output, and accessory modules; power supplies, batteries, supervision of wiring, etc.
2. 80 character LCD display for displaying system events and keypad for input and programming functions. Plain English description of the location of each device.
3. Password protection for programming and system settings.
4. Provide the required quantity of input and output cards within the main control panel enclosure required for the system zoning plus spare capacity as described elsewhere in this specification.
5. Communication between main control panel and remote devices via RS-485 data lines.
6. Provide adequately sized power supply to power all system devices.
7. Provide alarm, trouble and supervisory silence, reset and drill functions.
8. Lamp test switch.
9. Monitors each remote initiating device and compensate for long term drift. Initiates a unique alarm when a detector requires maintenance due to excessive dirt/dust buildup.
10. Adjustable programmable day/night and weekend sensitivity setting ability.
11. One person-walk through system test on a zoned basis.
12. Password protection for administration and maintenance purposes.
13. Provide a durable, baked enamel finish for the main control panel enclosure.
14. UL listed (864).

B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site, and off-site via dial-up service modem, programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory. Full flexibility for selective input/output control functions based on ANDing, ORing, NOTing, timing, and special coded operations shall also be incorporated in the resident software programming of the system.

C. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in, for instance, sensing of normally open contact devices to sensing of normally closed contact devices, or from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices on the same circuit and being able to differentiate between the two, or changing from a non-verification circuit to a verification circuit or vice-versa.

D. Resident software shall also allow for configuration of indicating appliance and control circuits so that additional hardware shall not be necessary to accommodate changes in, for instance changing a non-coded indicating appliance circuit to a coded circuit, or from a slow march time (20 BPM) to a fast march time (120 BPM).

E. Provide a system that records system events (in chronological order) including the following:

1. Supervisory alarms

2. Trouble alarms

3. Fire alarms.

F. Provide a digital alarm communication transmitter to allow alarms to be transmitted to a constantly attended off-site alarm monitoring company. Verify with the Owner the location, phone number and required protocol to provide communications between the panel and the off-site monitoring station. Provide individual point-by-point monitoring to the monitoring company for each point in the fire alarm system. **(DELETE/SELECT/EDIT) for data connections**

G. Provide power and control wiring to automatic closing and self closing devices (door holders, fire shutters, smoke dampers, etc.), relays, HVAC unit starters, and any other interfaces to equipment required to be interfaced to the fire alarm system.

H. Provide the required communications port in the main control panel to allow a future printer to be plugged into the system for printing hard copies of all system events and history logs.

2.3 REMOTE ANNUNCIATOR PANELS *(SELECT/DELETE)*

A. Provide remote annunciator panels with the following specifications:

1. Mounted in vandalproof enclosure (specified elsewhere herein).

2. Six (6) Status indicator LEDs:

a. Fire Alarm & Priority 2 Alarm, red LED

b. Supervisory & Trouble, yellow LED

c. Alarm Silenced, yellow LED

d. AC Power, green LED (on for normal)

3. Minimum of five (5) programmable function buttons (unless fire alarm sequence of operations requires more).

4. Minimum of three (3) programmable status LED's (unless fire alarm sequence of operations requires more).

5. (SELECT/DELETE) For ULC systems, program one (1) of the three programmable status LED's above for Ground Fault Indication.

6. All switches, buttons and indicators located behind a transparent faceplate.

7. Supervised wiring between annunciator and the main control panel.

8. 2 line x 40 character display (total of 80 characters).

9. Powered from the main control panel.

10. Unique alarm and trouble notification signal at panel. Acknowledge, reset, silence and scroll forward and back functions for viewing system event history log.

B. (SELECT/EDIT) Locate remote annunciator(s) as indicated on the drawings.

2.4 STANDBY BATTERIES

A. Provide standby batteries in accordance with the requirements of NFPA 72 that are appropriately sized to operate the fire alarm system for a minimum of twenty-four (24) hours and then operating all indicating units for at least five (5) minutes after the 24 hours, **plus an additional 10% spare capacity.**

B. Provide battery charger sized to fully charge all standby batteries within eight (8) hours after a full discharge cycle.

C. Provide maintenance-free, sealed gel cell or sealed lead-acid batteries. Batteries which vent gases are not acceptable.

D. Mount batteries inside the main control panel enclosure on the bottom. Separate battery enclosures are not acceptable.

E. Provide monitoring of batteries, charger and associated wiring from the main control panel.

F. Provide a voltmeter and ammeter to indicate battery voltage and charging current through the front LCD display on the fire alarm control panel.

2.5 MANUAL STATIONS

A. Provide manual pull stations with the following specifications:

1. Single action type (non-break glass type).
2. Die cast aluminum construction with baked red enamel finish.
3. Semi flush mounted to recessed backbox.
4. Pull lever locks in the protruding position when actuated.
5. Key lock switch for resetting handle and for testing purposes.
6. Fully enclosed silver plated contacts configured as normally open or normally closed.
7. UL listed.

B. Provide vandalproof shield over each manual pull station, to sound a local alarm when the shield is raised. Refer to "Vandal Equipment" specified elsewhere in this section.

C. Provide manual station with addressable communications module or provide addressable communications module immediately adjacent to manual station.

D. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

2.6 VANDAL EQUIPMENT

A. Manual pull station vandal shields

1. Provide a UL listed clear polycarbonate hinged shield with integral peizo alarm to sound a local alarm when the shield is raised. Provide batteries for each.
   a. Safety Technology International #1100/#6600 Series or pre-approved equal.

B. Wire guards

1. Provide heavy gauge (16 Ga. minimum), white steel guard for smoke or heat detectors where indicated on the drawing or specified herein.
   a. Shaw Perkins model SDG, Pro-Tec model 2000 series or pre-approved equal.
2. Provide manufacturer-approved wire guards for horns, strobes and horn/strobe units where indicated on the drawings or specified herein.
3. Provide wire guards over horn/strobe units in the gymnasium.

C. Clear Plastic Guard.

1. Provide clear plastic cover guard where indicated on the drawing or specified herein.

D. Vandal proof enclosures

1. Where vandalproof equipment enclosures are noted in this specification and on the plans, provide enclosures with the following specifications:

   a. Heavy duty sheet metal with piano hinge

   b. Minimum ¼" thick clear lexan faceplate.

   c. BEST/SCHLAGE lock, keyed to the Owner's master.

   d. Secured to the wall with approved anchoring hardware.

   e. Verify color with Owner.

2.7 INTELLIGENT AUTOMATIC PHOTOELECTRONIC SMOKE DETECTORS

A. Provide automatic photoelectronic smoke sensors with the following specifications:

1. Utilizes light scattering principle from an internal infrared LED light source and reports the percent obscuration to the main control panel.

2. Factory set threshold at a nominal 1.5% light obscuration per foot (set via the main control panel)

3. Operates +14 to +120 degree F temperature, 10% to 93% humidity range.

4. Operates on single twisted pair cable.

5. Self-compensating drift compensation for maximum stability (set via the main control panel).

6. Integral red LED visible to the eye from below the detector to indicate an alarm condition and to indicate the polling pulse from the main control panel.

7. Mounts to base by twist locking motion.

8. U.L. 268 listed.

B. Provide detector base with addressable communications module.

C. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

2.8 INTELLIGENT AUTOMATIC HEAT DETECTORS

A. Provide automatic heat detectors with the following specifications:

1. Utilizes a combination of fixed temperature and rate of rise compensation (temperature exceeds 15 degree per minute rise, set via the main control panel).

2. Operates at +14 to +122 degree F temperature, with relative humidity less than 93%.

3. Integral red LED visible to the eye from below the detector to indicate an alarm condition and to indicate the polling pulse from the main control panel.

4. Mounts to base by twist locking motion.

5. U.L. 521 listed.

B. Provide detector base with addressable communications module.

C. Provide ordinary rated (135 degree F) detectors in normal spaces. Provide intermediate rated (175 degree F) in unconditioned spaces such as boiler rooms or other areas with a high ambient temperature.

D. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

2.9 INTELLIGENT PHOTOELECTRONIC DUCT SMOKE DETECTORS

A. Provide automatic photoelectronic duct smoke sensors with the following specifications:

1. Utilizes light scattering principle from an internal infrared LED light source and reports the percent obscuration to the main control panel.
2. Factory set threshold at a nominal 1.5% light obscuration per foot (set via main control panel)
3. Self-compensating drift compensation for maximum stability (set via main control panel).
4. Operates at air velocities from 300-4000 ft/min, +32 to +120 degree F operating temperature, 10%-93% humidity range.
5. Operates on single twisted pair cable.
6. Smoke chamber blocks particles larger than 200 microns.
7. Integral red LED visible to the eye from outside the detector housing to indicate an alarm condition and to indicate the polling pulse from the main control panel.
8. Mounts to housing/base by twist locking motion.
9. U.L. 268 listed.

B. Provide detector base with addressable communications module.

C. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

D. Provide HVAC duct-mounted housing and sampling tubes of the proper length to sample the entire width of the HVAC duct. Provide additional duct smoke detectors as required for ducts wider than the longest sampling tube recommended by the fire alarm manufacturer.

E. Provide addressable control module and associated relay rated at 10 amps for connection to HVAC unit starter circuit for fan motor shutdown. Provide unique address assignment for each control module, either through DIP switches located in the control module or assigned by the main control panel.

F. Provide addressable control module and associated relay for connection to combination smoke/fire dampers. Provide unique address assignment for each control module, either through DIP switches located in the control module or assigned by the main control panel.

G. Provide remote test station for each duct detector in a readily accessible location near the unit. Provide engraved label on remote test station denoting the location, HVAC unit number, “RETURN”, damper location, etc. as required to identify the detector’s location and function.

2.10 BEAM SMOKE DETECTORS (SELECT/DELETE/EDIT)

A. Provide beam smoke detector with the following specifications:

1. Utilizes percent obscuration from a light source in the transmitter reported at the receiver to determine alarm and trouble.
2. Self-compensating drift compensation for maximum stability.
3. Operates at +32 to +130 degree F operating temperature and up 95% humidity range (noncondensing).

4. Operates on a 4-wire cable between the transmitter and receiver pair, and one twisted pair cable between the communications module and the main control panel.
5. Integral LEDs visible to the eye from outside the detector housing to indicate an alarm or trouble condition, and to indicate the polling pulse from the main control panel.
6. Mounts to wall or ceiling.
7. U.L. listed.

B. Provide addressable communications module with each transmitter/receiver pair to communicate alarm and trouble signals to the main control panel.

C. Provide unique address assignment for each beam detector transmitter/receiver pair, either through DIP switches located in the communication module or assigned by the main control panel.

2.11 AUTOMATIC-CLOSING AND SELF-CLOSING DEVICES (SELECT/DELETE/EDIT) WHO PROVIDES AND WHO INSTALLS?

A. Includes magnetic door holders, automatic doors and rolling fire shutters (provided by others)

B. Provide magnetic door holder with the following specifications:

1. Minimum holding force of 25 lbs.
2. Surface, wall mounted.
3. Operates at 24 VDC from the fire alarm panel.
4. U.L. listed.

C. Provide interface wiring between each closing device and the fire alarm system.

D. Provide power to 24 VDC and 120 VAC closing devices.

E. Provide Firemark FM 996 in surface mounted applications, Firemark FM 998 elsewhere.

F. Provide addressable control module at each closing device to allow the main control panel to actuate each closing device independently.

G. Provide unique address assignment for each self closing device, either through DIP switches located in the control module or assigned by the main control panel.

H. Provide addressable control module wiring between each closing device and the fire alarm system to allow the main control panel (through software) to operate the devices in either of two ways:

a. Any alarm in the building closes all automatic closing and self-closing devices.
b. Only the detectors adjacent to the automatic closing and self-closing devices close the devices.

2.12 COMBINATION FIRE/SMOKE DAMPERS

A. Provided by Mechanical Contractor. Verify damper type and locations with Mechanical Contractor.

B. Unless noted otherwise, provide intelligent duct detector located upstream of damper.

C. Provide addressable control module at each damper to allow the main control panel to actuate each damper independently.

D. Provide unique address assignment for each damper, either through DIP switches located in the control module or assigned by the main control panel.

E. Provide power wiring from fire alarm system through the control module to the damper's associated EP (electric-pneumatic) switch. EP switch by Mechanical Contractor. (SELECT/DELETE/EDIT).

F. Provide power wiring from fire alarm system through the control module to the damper's associated DDC (damper control).

2.13 AUTOMATIC SPRINKLER WATERFLOW SWITCHES

A. Provided by Mechanical Contractor.

B. Provide addressable communications module for each waterflow switch to communicate alarm and trouble signals to the main control panel.

C. Provide unique address assignment for each waterflow switch, either through DIP switches located in the communication module or assigned by the main control panel.

2.14 AUTOMATIC SPRINKLER VALVE POSITION (TAMPER) SWITCHES

A. Provided by Mechanical Contactor

B. Provide addressable communications module for each valve position switch to communicate trouble and supervisory signals to the main control panel.

C. Provide unique address assignment for each valve position switch, either through DIP switches located in the communication module or assigned by the main control panel.

2.15 DOMESTIC WATER SHUTOFF SOLENOIDS

A. Solenoids provided by Mechanical Contractor. Provide 120 volt power wiring to the solenoid.

B. Provide addressable control module to allow the fire alarm system to control the state of the solenoid. Provide control wiring between the solenoid and the control module.

C. Provide unique address assignment for the control module, either through DIP switches located in the control module or assigned by the main control panel.

D. Provide system programming to shut the solenoids (remove power to the solenoid) if water flow is detected by any sprinkler flowswitch.

2.16 ALARM INDICATING HORNS

A. Provide alarm indicating horns with the following specifications:

1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less that 180 seconds.
2. Semi-flush mounting to 4-inch square electrical box
3. 24 VDC operation powered from the main control panel.
4. A minimum 90 dB output at 10 feet on axis.
5. Red with white "Fire" lettering.
6. Supervised wiring.
7. U.L. listed, ADA compliant

2.17 ALARM INDICATING STROBES

A. Provide alarm indicating strobes with the following specifications:

1. Semi-flush mounting to 4-inch square electrical box

2. 24 VDC operation powered from the main control panel.
3. In rooms larger than 1600 square feet
   a. Minimum 120 candela when measured on axis
   b. Rated for wall mount applications per UL 1971 at a minimum of 110 candela effective intensity.
4. Non-assembly rooms and corridors
   a. Minimum 75 candela when measured on axis
   b. Rated for wall mount applications per UL 1971 at a minimum of 15 candela effective intensity.
5. One to three flashes per second with a one (1) hertz synchronous flash pattern in accordance with ADA.
6. Red with white "Fire" lettering. Vandal-proof polycarbonate lens.
7. Supervised wiring
8. U.L. 1971 listed, ADA compliant

2.18 ALARM INDICATING HORN/STROBE UNIT

A. Provide horn/strobe units with the following specifications:
1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less than 180 seconds.
2. Semi-flush mounting to 4-inch square electrical box
3. 24 VDC operation powered from the main control panel.
4. A minimum 90 dB output at 10 feet on axis.
5. Strobe light with the specifications of the strobe unit specified elsewhere in this section.
6. Red with white "Fire" lettering. Vandal-proof polycarbonate lens.
7. Supervised wiring
8. U.L. 1971 listed, ADA compliant

2.19 SPEAKER NOTIFICATION APPLIANCES

A. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.

B. Communication transducers multi-tapped 1/4W to 2 W, with moisture-resistant, sealed compression driver.

C. Sensitivity: 87 – 96 dBA on-axis at 10' or higher if required for vendor-supplied layout drawings.

D. Frequency response: 400-4000 Hz for tonal signaling and 125- 12,000 Hz for general signaling.

E. Matching Transformers: Tap range matched to acoustical environment of speaker location.

F. Mounting Faceplate: Factory finished, red.

2.20 ALARM INDICATING SPEAKER/STROBE UNIT

A. Provide speaker/strobe units with the following specifications:

1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less than 180 seconds.
2. Semi-flush mounting to 4-inch square electrical box
3. 24 VDC operation powered from the main control panel.
4. A minimum 90 dB output at 10 feet on axis.
5. Strobe light with the specifications of the strobe unit specified elsewhere in this section.
6. Red with white "Fire" lettering. Vandal-proof polycarbonate lens.
7. Supervised wiring
8. U.L. 1971 listed, ADA compliant

2.21 (SELECT/DELETE) TEXTUAL READER BOARDS (TEXT MESSAGING APPLIANCE)

A. Nominal 30" x 18" LED high visibility reader board for notification of fire alarm and alternate events.

B. Minimum viewing distance of 100 feet.

C. UL listed to Standard 1638, Textual Visible Appliance.

D. UL listed for use in a fire alarm system.

E. Powered and controlled by Main Fire Alarm Panel.

F. Text messages to be selected by Owner in the field and programmed into the system as directed.

2.22 *(SELECT/DELETE)* NOTIFICATION DEVICE (LIGHTED PANEL)

A. Nominal 7-1/2" H x 12" W x 2-1/2" D lighted LED Panel with "ANNOUNCEMENT" and "EVACUATE" selectable messages.

B. Manufacturer: Notifier SP-series lighted panel or approved equal.

C. This system will be provided as a "supplemental notification" to the private mode function of the fire alarm system and Owner's program.

D. Configure such that a general fire alarm condition will light "EVACUATE" message. Configure input causing "ANNOUNCEMENT" message as directed in the field by Owner.

E. Supervise all wiring to each unit. Provide additional monitor modules as required.

2.23 ADDRESSABLE MONITOR MODULE

A. Provide addressable monitor modules to serve as interfaces between the fire alarm system and ancillary systems where indicated on the drawings.

B. Provide with ability to monitor devices with normally-open (NO) contacts.

C. Match style and configuration of existing wiring. Provide with integral EOL resistor if required.

D. Provide enclosures for modules where not part of factory equipment.

2.24 ADDRESSABLE CONTROL MODULE

A. Provide addressable control modules to serve as interfaces between the fire alarm system and ancillary systems where indicated on the drawings.

B. Provide with ability to provide a contact closure for control of devices. Provide with both normally-open (NO) and normally-closed contacts. Contacts on control module shall be rated for the proper voltage and current of the control circuits to which they are interfaced. Additional interfaces, if required to meet amperage or voltage requirements of the control system, are the responsibility of the contractor.

C. Match style and configuration of existing wiring. Provide with integral EOL resistor if required.

2.25 SYSTEM WIRE AND CABLE

A. Provide all conductors and cables in conformance with the National Electrical Code Section 760-30.

B. Size all initiating and indicating circuit wiring as recommended by the system manufacturer. Provide minimum 14 AWG size for indicating and control circuits, and 18 AWG for initiating circuits.

C. Provide shielded cable to minimize RFI if recommended by the manufacturer.

D. Provide maximum individual circuit voltage drop of 15% at the most distant device; or less if necessary to meet the manufacturer's operating voltage range for all devices.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATIONS

A. Remote station monitoring

1. The following system conditions shall initiate the communicator to transmit the point-specific information to the remote monitoring location:
   a. Sprinkler waterflow alarm.
   b. Any fire alarm condition initiated by a manual pull station.
   c. Any verified automatic detector alarm.
2. The following system conditions shall **not** initiate the communicator to transmit the alarm information to the remote monitoring location:
   a. Smoke duct detectors required for HVAC unit shutdown.
   b. Detectors required for the automatic release of fire doors.
   c. Detectors required for the automatic release of combination fire/smoke dampers.
   d. Detectors used for kitchen equipment power shutoff.
3. Automatic detectors at the following locations shall initiate a supervisory signal, not a general alarm:
   a. Smoke duct detectors required for HVAC unit shutdown.
   b. Detectors required for the automatic closure of fire doors and fire shutters.
   c. Detectors required for the automatic closure of fire/smoke dampers.

B. Walk test mode

1. The actuation of the "enable walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:
   a. The city circuit connection shall be bypassed.

b. Control relay functions shall be bypassed.

c. The control panel shall show trouble condition.

d. The alarm activation of any initiation device shall cause the audible signals to code a number of pulses to match the zone number.

e. The panel shall automatically reset itself after signaling is complete.

f. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.

g. The system shall have the capacity of 8 distinctive walk test groups, such that only a portion of the system need be disabled during testing.

C. (SELECT/DELETE: CONFIRM WITH AHJ) Provide an adjustable alarm verification feature (as allowed in NFPA 72) to reduce the number of false alarms. Provide a system with programmable acknowledge time delay and reset time periods, within the allowable limits set by UL for the system. The activation of any system smoke detector shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute, the system shall resume normal operation. The alarm verification shall operate only on smoke detector alarms. Other activated initiating device shall be processed immediately. The alarm verification operation shall be selectable by zone or addressable point. Each time a detector initiates an alarm verification operation, it shall be recorded into the alarm verification historical log.

D. The control panel shall have the capability to display the number of times (tally) a zone, or addressable point, has gone into a verification mode. Should this smoke verification tally reach a pre-programmed number, a trouble condition shall occur.

E. Alarm verification zones shall be able to be divided into eight separate groups whereby only verification zones from the same group will confirm the first activation and cause the alarm sequence to occur.

F. Provide the following sequence of events after the main control panel has determined that an alarm condition exists within the building, and the alarm has been verified:

1. Sound the alarm notification signal at the main control panel and all remote annunciators.

2. Display in plain English the description of the location of the device in alarm at the main control panel and each remote annunciator.

3. Activate all audible and visual indicating devices in the associated indicating zone within the building. Activate all audible alarm indicating devices in a synchronous temporal pattern and all visual indicating devices in a one (1) hertz synchronous flash pattern until silenced by the alarm silence switch at the control panel or remote annunciator.

4. Close the domestic water shutoff solenoids at the sprinkler service(s) if water flow is detected by any sprinkler flow switch.

5. Release all self-closing and automatically closing devices powered by the fire alarm system within the building.

6. Shut off any monitored HVAC system if smoke is detected by the associated HVAC unit duct detector.

7. Initiate the communication/modem device to transmit the point-specific information to the off-site monitoring station.
8. Recall the elevator cab if any elevator lobby, elevator equipment room, or top of hoistway smoke detector goes into alarm according to the following sequence:
    a. If the alarmed detector is in the elevator equipment room, top of hoistway, or in the elevator lobby on any floor other than the main level of egress, the elevator cab shall be recalled to the main level of egress.
    b. If the alarmed detector is in the elevator lobby on the main egress level, the elevator cab shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.
9. Store the event in the history log.

G. Provide the following sequence of events after the main control panel has determined that a trouble condition exists within the building:
    1. Sound the trouble notification signal in the main control panel and all remote annunciators.
    2. Display in plain English the description of the location of the device in trouble at the main control panel and each remote annunciator.
    3. Store the event in the history log.

H. Provide the following sequence of events after the main control panel determined that a supervisory condition exists within the building:
    1. Sound the trouble notification signal in the main control panel and all remote annunciators.
    2. Display in plain English the description of the location of the supervisory signal at the main control panel and each remote annunciator.
    3. Store the event in the history log.

I. Provide an interface to the building sprinkler system siamese connection indicating device on a separate indicating circuit. Provide alarm indication at the indicating circuit whenever water flow is detected. Provide a separate key switch at the main control panel to silence the indicating device.

J. If sprinkler water flow is detected by the kitchen hood water flow switch, the system shall shutoff electric power to the following:
    1. Electric appliances located under the hood.
    2. The exhaust fans serving the hood.
    3. The electric gas solenoid valve. A general building alarm shall not initiate equipment shutoff.

K. The following system conditions shall initiate the communicator to transmit the point-specific information to the remote monitoring location:
    1. Sprinkler water flow alarm.
    2. Sprinkler valve position switch supervisory alarm.
    3. Any fire pump supervisory, trouble or alarm condition.
    4. Any fire alarm condition initiated by a manual pull station.
    5. Any verified automatic detector alarm.

L. The following system conditions shall **not** initiate the communicator to transmit the alarm information to the remote monitoring location:

1. Smoke duct detectors required for HVAC unit shutdown.
2. Detectors required for the automatic release of fire doors.
3. Detectors required for the automatic release of combination fire/smoke dampers.
4. Detectors located within each dwelling unit.
5. Detectors used for elevator recall.
6. Detectors used for elevator power shutoff.
7. Detectors used for kitchen equipment power shutoff.

M. Automatic detectors at the following locations shall initiate a trouble signal, not a general alarm:

1. Smoke duct detectors required for HVAC unit shutdown.
2. Detectors required for the automatic closure of fire doors and fire shutters.
3. Detectors required for the automatic closure of fire/smoke dampers.
4. Detectors located in elevator lobbies and machine rooms required for the recall of elevators.

N. Provide green LED and the word NORMAL on the LCD display if the system is in its normal operating mode, and no alarms or faults exist in the system.

O. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, alarm functions would occur as described previously.

P. The control panel shall maintain a moving average of the sensor's smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. Photoelectric smoke detector smoke obscuration sensitivity shall be adjustable to within 0.2% of either limit of the UL window (0.2% to 4.0%) to compensate for any environment.

Q. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined level, a "DIRTY SENSOR" trouble condition shall be audibly and visibly indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. If a "DIRTY SENSOR" is left unattended, and its average value increases to a second predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel for the individual sensor. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate an "ALMOST DIRTY" indication for any sensor approaching a "DIRTY" trouble condition. This report shall generate a list of sensor approaching a "DIRTY" trouble condition. This report shall generate a list of sensors requiring cleaning in advance of any trouble indication.

R. The control panel shall continuously perform an automatic self-test routine on each sensor which will functionally check sensor electronics and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition with the sensor location at the control panel.

S. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:

1. Primary status
2. Device type
3. Present average value
4. Present sensitivity selected
5. Peak detection values
6. Sensor range (normal, dirty, etc.)

T. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1. Clear peak detection values
2. Enable or disable the point
3. Clear verification tally
4. Establish alarm sensitivity
5. Control a sensor's relay driver output

U. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week. There shall be five (5) sensitivity settings available for each sensor.

V. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3% sensor reaches a threshold of 1.5% smoke obscuration.

W. Adjust the sensitivity of the elevator lobby smoke detectors to maximum sensitivity.

3.2 INSTALLATION

A. Provide a complete and fully operational fire alarm and detection system as described herein and as shown on the drawings.

B. Provide a two wire Class B, low voltage, power limited, ADA compliant, addressable, closed circuit, electrically supervised, non-coded, temporal sounding type system as described in NFPA 72.

C. Provide individual alarm and trouble indication for each initiating device.

D. Provide supervisory signal indication for the sprinkler valve position switches (provided by others). Provide separate and unique monitoring of each valve position switch.

E. Provide supervision of the following circuits and devices:

1. Each individual initiating device and associated wiring
2. Each individual indicating device and associated wiring
3. Fire pump and fire pump wiring status.
4. Standby battery voltage.
5. Battery wiring.
6. Power supply voltage

7. CPU operation
8. Communications/Modem
9. Error Memory
10. Software Configuration
11. Hardware Configuration
12. Remote sub-panels, power supplies and associated wiring between the sub-panel and the main control panel.

F. Provide a clear distinction (at the main control panel and remote annunciators) between the alarm notification signal and the trouble notification signal.

G. Provide automatic HVAC system shut down for air handling units that move an air volume in excess of 2000 cfm. Provide duct detectors in the return ducts, and addressable control modules at each motor starter.

H. Install and wire all equipment in accordance with this specification, project drawings and shop drawings.

I. Provide all wiring, conduit, junction boxes and outlet boxes required for the system, including terminations to initiating, indicating and control devices furnished by others.

J. Install all wiring in concealed conduit in new construction. Provide surface raceway and boxes in finished areas of existing construction. Reuse existing conduit and boxes wherever possible.

K. Paint all junction boxes red and label “Fire Alarm”.

L. Provide plain English description of the location of each initiating device (zone). Coordinate wording of each device with the Owner.

M. Provide a laminated floor plan showing all device locations, addresses and plain-English description of the location. Mount the plan adjacent to the annunciator panel in the building Engineer’s office.

N. Provide color coded wiring throughout. Test all wiring for opens, shorts and grounds before system startup.

O. Terminate all fire alarm wiring at terminal strips at the main control panel and all annunciator panels. Identify each cable with a number corresponding to a wiring diagram to be submitted in the O&M manuals. Neatly arrange of cabling around the sides of the cabinets to facilitate servicing of equipment and modules.

P. Provide the required system programming. Coordinate with the Owner all plain English address points, alarm verification presets, passwords, communication dialer protocol information, etc.

Q. Coordinate the installation of the fire alarm system with mechanical contractor. Verify locations of sprinkler waterflow switches and valve position switch locations with mechanical contractor. Provide wiring and make terminations to sprinkler waterflow devices and valve position switches being installed by mechanical contractor.

R. Coordinate the installation of the fire alarm system with mechanical contractor. Verify locations of smoke damper and EP switch locations with mechanical contractor. Provide wiring and make terminations to EP switches being installed by mechanical contractor.

S. Provide and install power to magnetic door holders, including wiring and connections through the associated smoke detector. Wire existing magnetic door holder wiring through the associated smoke detector base for automatic closure if the smoke detector senses smoke.

T. Mount end-of-line resistors in separate junction box located near the last device in the circuit or in last device. Clearly and permanently label "EOL RESISTOR" at each junction box cover plates and/or devices containing EOL resistors.

U. Provide one 3/4 inch conduit and telephone cable from main fire alarm control panel to the telephone terminal board for tie-in to remote monitoring company. Verify location with Owner.

V. Provide and connect wiring from the duct smoke detector control modules to associated motor controllers.

W. Install smoke detectors after the site is free from abnormal dust and dirt conditions, or provide manufacturer-approved protective cover over the device until the site is clean.

X. Provide permanent labels for controls and indicators.

Y. Provide Form C relays where required to control line voltage equipment.

Z. Mount fire alarm devices to electrical boxes.

AA. Locate automatic detectors a minimum of 36 inches away from supply air diffusers.

3.3 PLENUM CABLE INSTALLATION *(SELECT/DELETE/EDIT)*

A. Plenum rated conductors are to be installed above accessible, suspended ceilings. Provide conduit for all exposed areas. Where provided utilize cable trays. Do not utilize cable trays provided for voice/data cabling.

B. Provide bushings on all conduit drops to outlet boxes for devices installed in walls.

C. Route all cables to avoid access panels on equipment and in ceiling.

D. Support all cable at 5' intervals using "J" hooks. Fasten "J" hooks to building structure. Adhere to the manufacturer's maximum fill for the cable support hardware. Bundle cables to eliminate sagging between "J" hooks. Install "J" hooks to eliminate sagging on ceilings, ducts, pipes, etc.

E. Install cables without violating the minimum bend radius recommended by the cable manufacturer.

F. Maintain at least a 12" spacing from fluorescent light fixtures and other EMI/RFI noise sources.

G. No splices are allowed in individual runs of cables. If splices are required due to the construction schedule then splices are to be made within junction boxes. Notify engineer for inspection of junction boxes prior to installation of ceiling tiles.

H. Maintain conductor shields at each connection point and tie to ground. Conductor shields are to be continuous throughout the entire run of cable.

I. Provide test results indicating continuity of conductor shields. Replace all cables where shields have become nicked or cut.

J. Terminate all conductors in flush outlet boxes behind devices. Provide stress relief. Provide grommets where cables enter HVAC equipment.

K. Provide red plenum cable for fire alarm systems.

L. (SELECT/DELETE)Continuous, enclosed raceway and box systems are required for all smoke control system components-no free-air cable is allowed.

3.4 TESTS AND ADJUSTMENTS

A. Upon completion of the installation phase, test and adjust the system to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

D. Make an inspection of the fire alarm system with the manufacturer's representative of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal detectors, smoke detectors, flow switches and controls, whether or not manufactured by the manufacturer. The inspection to comprise examination and certification of such equipment for the following:

1. The system functions properly;
2. The type of equipment installed is that designated by the Engineer's specifications;
3. The wiring connections to all equipment components have been installed in accordance with UL requirements;
4. Equipment of the manufacturer has been installed in accordance with the manufacturer's recommendation and that all signaling devices of whatever manufacturer have been operated or tested to verify their operation: The supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the regulations, if any, concerning such supervisory wiring, have been met to the satisfaction of inspecting officials.

E. Inspection Certification: Upon completion of the inspection and when all of the above conditions have been complied with, the manufacturer is to issue to the Engineer:

1. A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
2. A certificate of verification confirming that the inspection has been completed and accepted by the authority having jurisdiction and showing the conditions upon which such inspection and certification have been rendered.

F. Owners Instruction: The manufacturer to provide the services of a competent alarm system technician for the period of two working days, at a time convenient to the Owner, to instruct the staff in the operation and maintenance of the system.

G. Provide a letter to the Owner and Fire Marshal certifying that the installed system is UL certified.

H. ***(DELETE/EDIT)*** Provide UL certification of complete fire alarm system (including all new and existing devices) for a period of five years.

I. ***(DELETE/EDIT)*** Provide complete UL testing of the entire fire alarm system (including all new and existing devices). Field verify exact mounting locations of all fire alarm devices.

Provide a UL certified maintenance and monitoring contract for the complete fire alarm system (including all new and existing devices) ***(EDIT)*** for a five year period, beginning on the date of final completion. Provide all required on-site maintenance and testing during this period performed by a UL certified service company.

3.5 TRAINING

A. Provide a minimum of eight (8) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.6 AS-BUILT DOCUMENTATION

A. Provide to the Engineer two (2) complete as-built manuals assembled in loose-leaf binders containing the following:

1. As-built system functional block diagrams.
2. Corrected copies of approved shop drawings

3. As-built system wiring diagram.
4. List indicating each device, location, address, label, etc.
5. Final operating sequence (step by step) for the system as tested and accepted by the Fire Marshal.
6. **Hard copy printout of the complete fire alarm operating program, and a CD-ROM disk with programming software as written and customized for this project.**
7. System operation manuals.
8. System maintenance manuals.
9. Name, address and phone number of the responsible service organization.

3.7 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer, to the Owner's representative(s) and the Fire Marshal.

B. Verify the following before scheduling the system demonstration:

1. System installation is complete.
2. System is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.8 SYSTEM GUARANTEE

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

3.9 MAINTENANCE

A. Maintain a local service organization which is available to perform testing, inspection, repair and maintenance service on the system.

B. Make available to the Owner a maintenance contract proposal, from the system supplier to provide a minimum of two (2) inspections and test per year in compliance with NFPA-72 guidelines.

3.10 SPARE PARTS *(EDIT)*

A. Provide the following spare parts for the system:

1. Five intelligent smoke detectors with bases.
2. Five intelligent heat detectors with bases
3. One duct smoke detector housing and sampling tubes
4. Five manual pull stations.

5. Two addressable control modules.
6. Two addressable monitor module.
7. 15 keys for fire alarm cabinets.

B. Turn spare parts over to Owner at the completion of the project. Provide written documentation signed by the Owner that the spare parts were turned over at the completion of the project.

END OF SECTION