Colorado Mountain College

SPRING VALLEY RENOVATION

Glenwood Springs, Colorado

HCM Project No. 221170.00

PROJECT MANUAL

Contract Documents

October 1, 2021

VOL 1 of 1, **Divisions 00 - 28**

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1800 Wazee Street Suite 450, Denver, CO 80202-2593, (303) 607-0977

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PROJECT DIRECTORY

Owner:
Colorado Mountain College
802 Grand Avenue
Glenwood Springs, CO 81601
Phone: 970-945-8691

Architect:
Hord Coplan Macht
1800 Wazee Street, Suite 450
Denver, CO 80202
Phone: 303-607-0977

Mechanical, Plumbing Engineer:
Cator Ruma & Associates, Co.
896 Tabor Street
Lakewood, CO 80401
Phone: 303-232-6200

Electrical Engineer:
Cator Ruma & Associates, Co.
896 Tabor Street
Lakewood, CO 80401
Phone: 303-232-6200

Information Technology:
NV5
2650 18th Street, Suite 202
Denver, CO 80211

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under Owner's separate contracts.
4. Owner-furnished/Contractor-installed (OFCI) products.
5. Contractor's use of site and premises.
6. Coordination with occupants.
7. Work restrictions.
8. 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.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Colorado Mountain College Spring Valley Renovation.

1. Project Location: 3000 County Road 114, Glenwood Springs, CO 81601.
2. HCM Project Number: 221170.00.

B. Owner: Colorado Mountain College, 802 Grand Avenue, Glenwood Springs, CO 81601.

C. Architect: Hord Coplan Macht, 1800 Wazee Street, Suite 450, Denver, CO 80202, 303-607-0977 Contact: Heather Morehead, hmorehead@hcm2.com.

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

1. Mechanical, Plumbing, Electrical Engineer:

a. Cator Ruma & Associates, Co., 896 Tabor Street, Lakewood, CO 80401, 303-232-6200 .

2. Information Technology, Security, and Audio/Visual:

a. NV5, 1550 Larimer St. #462, Denver, CO 80202, 720-213-7550.

E. Contractor: To be determined.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Interior renovation of existing garden-level building space to make a new nursing education and simulation space, and related plumbing, mechanical, and electrical and other Work indicated in the Contract Documents.

B. Type of Contract:

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

1.6 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

1. Information technology cabling and terminations.

1.7 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Specialtes:

a. Toilet, bath, and laundry accessories.

1) Paper towel dispensers.
2) Soap dispensers.
3) Waste receptacles.
4) Hand sanitizer dispensers.

b. Plastic-Laminate-Clad lockers.

1) See 012300 "Alternates" that affect PLAM lockers scope.

2. Audio/Video Equipment:

a. Wall-mounted televisions.

1.8 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.

B. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

C. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

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

E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.10 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 to normal business working hourse of 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

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 arranging for 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 not less than two days in advance of proposed disruptive operations.
2. Obtain Architect's written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

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

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

1.11 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.

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 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.

1.4 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 Part 3 "Schedule of Alternates" Article 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. Provide Alternates as described on Drawing Sheet A-101A "ALTERNATES".

END OF SECTION

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

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

1.3 DEFINITIONS

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

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 to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying 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 CSI 13.1A or comparable 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, from ICC-ES and other applicable code organizations.
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.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 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. Requested substitution provides sustainable design characteristics that specified product provided for compliance with sustainable design requirements.
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: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions (ASIs) authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, using Architect's standard ASI form, AIA Document G710, or other comparable form.

1.4 PROPOSAL REQUESTS

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

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

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

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.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on Architect's form, an AIA form, or other form acceptable to the Architect.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on Architect's form, an AIA form, or other form acceptable to the Architect. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

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

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

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

1. 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.
3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

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

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

a. Project name and location.
b. Owner's name.
c. Owner's Project number.
d. Name of Architect.

e. Architect's Project number.
f. Contractor's name and address.
g. Date of submittal.

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

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

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

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. 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.

6. 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.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
11. 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.
12. 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.

1.5 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 Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

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

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

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

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

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

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

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

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 subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

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. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.
7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
13. Initial progress report.
14. Report of preconstruction conference.
15. Certificates of insurance and insurance policies.
16. Performance and payment bonds.
17. 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.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

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. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. 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.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. General coordination procedures.
2. RFIs.
3. Digital project management procedures.
4. Web-based Project management software package.

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

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

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

1.4 INFORMATIONAL SUBMITTALS

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

1. Name, address, 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.

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

1.5 GENERAL COORDINATION PROCEDURES

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

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

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

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

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

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

1.6 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 to avoid delays in Contractor's work or work of subcontractors.

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

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

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

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five (5) working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. 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 5 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 . 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.
8. Identification of related Minor Change in the Work, Construction Change Directive, or Proposal Request, as appropriate.

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 three days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Architect's Digital Data Files: Electronic digital data files of drawings can be provided by the Architect for the Contractor's use, upon request, and at the Architect's discretion.

1. Contractor and all Subcontractors proposing to use furnished digital data shall execute a data licensing agreement in the form of the "Agreement for Use of Digital Data" included in the Project Manual following this Section.
2. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
3. Digital Format: Digital data may be available in Revit (BIM), AutoCAD, or PDF, contingent upon the Project.
4. The following information types may be furnished:

a. Architectural floor plans.
b. Architectural reflected ceiling plans.
c. Other drawing types at the Architect's discretion.

B. Web-Based Project Management Software Package: Use Architect's NEWFORMA web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
b. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
c. Document management for Drawings, Specifications, and coordination drawings, including revision control.
d. Management of construction progress photographs.
e. Mobile device compatibility, including smartphones and tablets.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

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

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

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

1. 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. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Sustainability best-practices.

1) For Projects in-general, discuss sustainability best practices; endeavor to use recycled content, limit VOCs, and recycle construction waste.

p. Preparation of Record Documents.

q. Use of the premises and existing building.
r. Work restrictions.
s. Working hours.
t. Owner's occupancy requirements.
u. Responsibility for temporary facilities and controls.
v. Procedures for moisture and mold control.
w. Procedures for disruptions and shutdowns.
x. Construction waste management and recycling.
y. Parking availability.
z. Office, work, and storage areas.
aa. Equipment deliveries and priorities.
bb. First aid.
cc. Security.
dd. 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. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

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

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

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

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

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

E. Progress Meetings: 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

HCM AGREEMENT FOR USE OF DIGITAL DATA

HCM Project Name: _____

HCM Project Number: _____

Contractor Recipient: _____

Drawings Requested: _____

Digital Format Requested: _____

Hord, Coplan Macht, Inc. (HCM) and its Sub-consultants are preparing Construction Documents on a computer system, which are being published for bidding and construction purposes. The undersigned has requested to be provided certain digital data in specific digital format. HCM and its Sub-consultants will provide services to develop modified copies of digital files for this project with the following understanding and conditions:

1. The undersigned understands that the digital data has not been finally verified against published versions, and thus may contain errors and extraneous data. Data stored on electronic media can deteriorate undetected and may be modified or altered without the knowledge of HCM and its Sub-consultants. The use of the digital data is wholly at the risk of the undersigned.
2. The published version of these documents as issued by HCM and its Sub-consultants is to be relied upon for the purposes of bidding and construction, not the digital data released for this request. To the extent there is any variation between the published version and the digital data thereof, the published version is the sole basis for determining all matters relating to the Work.
3. The use of the digital data shall not in any way obviate the undersigned's responsibility for the proper checking and coordination of as built conditions, dimensions, details, member sizes and gauge, and quantities of materials as required to facilitate complete and accurate fabrication and erection.
4. The digital data was generated utilizing commercial software under license to HCM and its Sub-consultants, and HCM and its Sub-consultants is under no obligation to provide any software or hardware required to read and manipulate the digital data. HCM and its Sub-consultants is also under no obligation to provide supplemental files, and linked data (e.g., font files, line types, or external references). The digital data to be provided for this project will be in a format as determined by HCM and its Sub-consultants.
5. HCM and its Sub-consultants is under no obligation to correct, modify, or update the digital data or to notify the undersigned of any need to correct, modify, or update the digital data.
6. Unless modified elsewhere, the digital data is the property of the design professional that produced it.
7. It is at the sole discretion of HCM and its Sub-consultants to determine the files to be released and any cost for the same.
8. The undersigned agrees to indemnify, defend, release, and hold HCM and its Sub-consultants, and the Owner harmless from any responsibility or obligation as to the accuracy or completeness of the digital data and further waives any claim it may have for expenses, including but not limited to attorney's fees, resulting from the undersigned relying upon or utilizing the digital data.
9. The digital files are provided for the exclusive use of the undersigned personnel ONLY. The information will not be transferred or transmitted by the undersigned for use by others. Any recipients intending to use this digital data need to sign and return this form.
10. The above shall constitute the entire agreement between Hord Coplan Macht, Inc. and its Sub-consultants and the undersigned for providing the above service.
11. This agreement does not constitute a waiver of copyright or a transfer of ownership of said information and documents. The said information and documents can be used only for the above referenced Project.

Contractor Signature: _____

Date: _____

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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. Site condition reports.
4. Unusual event reports.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.3 DEFINITIONS

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

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

1.4 INFORMATIONAL SUBMITTALS

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

1. PDF file.

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

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

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

E. Unusual Event Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

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

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, 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.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

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 Substantial Completion.

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

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. Temporary Facilities: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.

b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Interfaces with Separate Contracts.
f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time 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.

   a. Mechanical equipment.
   b. Ceramic tiling.
   c. Lighting fixtures.

4. 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.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. 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.
8. 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. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. 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.
6. Work Restrictions: Show the effect of the following items on the schedule:

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

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

   a. Subcontract awards.

b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:

1. Interior mock-ups review.
2. Electrical box-walks.
3. Important dates on Owner's schedule.

F. 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.

G. 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.

H. 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.

I. 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.

1.8 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.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

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.

1.9 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. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.

16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. 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.

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

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
8. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

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. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

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

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

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

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

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

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

    a. Door hardware.
    b. Security and access control.
    c. HVAC systems.
    d. Plumbing fixtures.
    e. Lighting fixtures.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to before being returned to Contractor.

    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

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

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

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 concurrently 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 unless submittal based on Architect's digital data drawing files is otherwise permitted.

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

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

C. Samples: Submit Samples for review of type, 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. 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.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

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

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

a. Number of Samples: Submit one full set(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.

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

    a. Number of Samples: Submit two (2) sets of Samples. Architect will retain one (1) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        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:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

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 AWS B2.1/B2.1M 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 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.
2. Submit delegated designs to the Authorities Having Jurisdiction (AHJ), in electronic format or paper copies, as required by the AHJ. Delegated designs that require submittal may include, but are not limited to the following:

    a. Fire alarm systems.
    b. Fire suppression systems.
    c. Structural engineering that is not provided by the project engineer-of-record.
    d. Some access control systems.

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 REVIEW

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

1. Architect will indicate, via markup on each submittal, the appropriate action, as follows:

    a. Approved or No Exceptions Taken (Proceed)
    b. Approved as Noted or Exceptions as Noted (Make minor corrections)
    c. Revise and Resubmit (Make non-minor corrections to otherwise acceptable submittal, and resubmit for the record)
    d. Rejected (Not acceptable in a significant way)
    e. No Action Taken or Required (for Informational Submittals)
    f. Not Required for Review (Not required by the Contract Documents, and not reviewed)

2. Architect’s consultants will indicate, via markup on each submittal, the appropriate action. Submittals will be returned to the Contractor through the Architect.

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 return without review 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

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SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes special procedures for alteration work.
   1. Procedures for ground-penetrating radar analysis of existing slab conditions prior to cutting, and/or installing anchors.

1.2 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

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

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

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

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. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

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

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

J. 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.

K. Retain: To keep an element or detail secure and intact.

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

1.3 COORDINATION

A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.

1. Schedule construction operations in sequence required to obtain best Work results.
2. Coordinate sequence of alteration work activities to accommodate the following:

    a. Owner's continuing occupancy of portions of existing building.
    b. Owner's partial occupancy of completed Work.
    c. Other known work in progress.
    d. Tests and inspections.

3. Detail sequence of alteration work, with start and end dates.
4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
5. Use of elevator and stairs.
6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.

B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns . Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

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. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed at Project site.

1.5 QUALITY ASSURANCE

A. 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.

B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work 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.

C. 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.

D. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.6 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

1. Clean loose dirt and debris from salvaged 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 on-site .
5. Protect items from damage during transport and storage.

B. Salvaged Materials for Reinstallation:

1. Repair and clean 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 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 alteration and other construction work in the vicinity is complete.

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

1. Identify each item for reinstallation 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 or more above the dew point.

E. Storage Space:

1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space includes climate control for stored material.
2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.7 FIELD CONDITIONS

A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs .

B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

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 alteration work.

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 alteration 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 alteration work.
5. Contain dust and debris generated by alteration 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 demolition work from other areas of the building.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

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 alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration 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 adhesive 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 alteration 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. General: 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.

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 welding or other high-heat equipment. Use of open-flame equipment is not permitted. 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 the 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 the proper operation of fire-control equipment and alarms.
    b. Prohibit fire-watch personnel from other work that would be a distraction 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.
    e. Maintain fire-watch personnel at each area of Project site until two hours after conclusion of daily work.

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 the type of fire risk in each work area. Ensure that nearby personnel and the 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, 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 alteration work 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 ALTERATION WORK

A. Have specialty work performed only by qualified specialists.

B. Ensure that supervisory personnel are present when 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 surveys of Project site as the Work progresses to detect hazards resulting from alterations.

E. 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.

3.5 GROUND PENETRATING RADAR (GPR) ANALYSIS

A. Core Drilling: If required based on existing slab conditions, employ methods of detecting existing tensioned and un-tensioned reinforcing, and other embedded items, that will not be hazardous to humans or damage Owner's existing facilities and equipment. If Owner has specific requirements, comply with those requirements.

1. Provide properly calibrated GPR equipment operated by an experienced GPR technician.
2. Review any available existing building conditions and drawings to be come familiar with existing and anticipated conditions and assemblies.
3. Prepare and submit a written report by the GPR Technician that presents findings.
4. Power-Actuated Fasteners and Post-installed Anchors: Verify existing slab conditions employing methods of detection specified for core drilling; locate fasteners and anchors to avoid structural damage to existing slabs and existing tensioned reinforcing.

END OF SECTION 013516

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Testing and 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. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. 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.
3. 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.

1.3 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 and Inspections: 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 Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

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 and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "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.

1.4 DELEGATED DESIGN SERVICES

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

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

B. Delegated Design Services Statement: 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.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is 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.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.

C. Reports: Prepare and submit certified written reports and documents as specified.

D. 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 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 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. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. 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. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. 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 is similar in material, design, and extent to those indicated for this Project.

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

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

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, 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, demonstrate, repair, and perform service on installations 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 Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. 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 not less than seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who 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.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Specialty Mockups: See Section 014339 "Mockups" for additional construction requirements for room mockups.

1.10 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.

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. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

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

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. 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. Contractor's Associated Requirements and 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. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and 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.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified 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.

B. Owner-Furnished Special Tests and Inspections: Special tests and inspections conducted by Owner's agent include, but are not limited to, the following:

1. Light Frame Construction.
2. Fire-Resistant Penetrations and Joints.

C. Contractor-Furnished Special Tests and Inspections: Special tests and inspections conducted by the General Contractor's Agent include, but are not limited to, the following:

1. Joint Sealant Testing.
2. Concrete Slab Moisture Testing.
3. Fume Hood Testing.
4. Fire Alarm.
5. Fire Sprinkler System.
6. Testing required for Warranty.

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 and authorities' having jurisdiction reference during normal working hours.

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

3.2 PRE-ROUGH-IN WALK-THROUGH

A. After framing installation and early during utility rough-in, schedule a walk-through of all spaces with Architect and Owner. Locations of all utilities and other requirements of the Contract Documents are to be reviewed and approved by the Owner at this walk-through.

3.3 PRE-CLOSE-IN WALK-THROUGH

A. Prior to wall close-in with application of wall finishes, schedule a walk-through with Architect and Owner, and Owner's Property Manager and maintenance personnel, in order to verify utility rough-in, blocking and/or backing, wall insulation, and other requirements of the Contract Documents. Coordinate walk-through attendance by subcontractors as necessary.

3.4 POST-CONSTRUCTION WALK-THROUGH

A. Approximately 9 months after Substantial Completion, schedule a walk-through with the Architect and Owner to review any items to be corrected prior to the end of the specified one-year correction period.

B. Just prior to one year after Substantial Completion of the Project, the General Contractor's Project Manager, Architect, and Owner shall inspect the Project in order to verify correction of warranty items addressed prior to the end of the specified one-year period of correction.

3.5 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

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

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

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

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

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

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

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

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

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

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

1.2 INDUSTRY STANDARDS

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

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

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

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

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

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (See FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.plib.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASSP - American Society of Safety Professionals (The); www.assp.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); www.avixa.org.
38. AWEA - American Wind Energy Association; www.awea.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.

40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
50. CDA - Copper Development Association; www.copper.org.
51. CE - Conformite Europeenne; www.ec.europa.eu/growth/single-market/ce-marking.
52. CEA - Canadian Electricity Association; www.electricity.ca.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.compositepanel.org.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa-group.org.
65. CSI - Cast Stone Institute; www.caststone.org.
66. CSI - Construction Specifications Institute (The); www.csiresources.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTA - Consumer Technology Association; www.cta.tech.
69. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.coolingtechnology.org.
70. CWC - Composite Wood Council; (See CPA).
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECA - Electronic Components Association; (See ECIA).
75. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
76. ECIA - Electronic Components Industry Association; www.ecianow.org.
77. EIA - Electronic Industries Alliance; (See TIA).
78. EIMA - EIFS Industry Members Association; www.eima.com.
79. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
80. EOS/ESD Association; (Electrostatic Discharge Association); www.esda.org.
81. ESTA - Entertainment Services and Technology Association; (See PLASA).
82. ETL - Intertek (See Intertek); www.intertek.com.
83. EVO - Efficiency Valuation Organization; www.evo-world.org.
84. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
85. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
86. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
87. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
88. FM Approvals - FM Approvals LLC; www.fmapprovals.com.

89. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
90. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
91. FSA - Fluid Sealing Association; www.fluidsealing.com.
92. FSC - Forest Stewardship Council U.S.; www.fscus.org.
93. GA - Gypsum Association; www.gypsum.org.
94. GANA - Glass Association of North America; (See NGA).
95. GS - Green Seal; www.greenseal.org.
96. HI - Hydraulic Institute; www.pumps.org.
97. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
98. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
99. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
100. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
101. IAS - International Accreditation Service; www.iasonline.org.
102. ICBO - International Conference of Building Officials; (See ICC).
103. ICC - International Code Council; www.iccsafe.org.
104. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
105. ICPA - International Cast Polymer Association; www.theicpa.com.
106. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
107. IEC - International Electrotechnical Commission; www.iec.ch.
108. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
109. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
110. IESNA - Illuminating Engineering Society of North America; (See IES).
111. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
112. IGMA - Insulating Glass Manufacturers Alliance; (See FGIA).
113. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
114. II - Infocomm International; (See AVIXA).
115. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
116. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
117. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
118. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
119. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
120. ISO - International Organization for Standardization; www.iso.org.
121. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
122. ITU - International Telecommunication Union; www.itu.int.
123. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
124. LMA - Laminating Materials Association; (See CPA).
125. LPI - Lightning Protection Institute; www.lightning.org.
126. MBMA - Metal Building Manufacturers Association; www.mbma.com.
127. MCA - Metal Construction Association; www.metalconstruction.org.
128. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
129. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
130. MHI - Material Handling Industry; www.mhi.org.
131. MIA - Marble Institute of America; (See NSI).
132. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
133. MPI - Master Painters Institute; www.paintinfo.com.
134. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
135. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
136. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
137. NADCA - National Air Duct Cleaners Association; www.nadca.com.
138. NAIMA - North American Insulation Manufacturers Association; www.naima.org.

139. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
140. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
141. NBI - New Buildings Institute; www.newbuildings.org.
142. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
143. NCMA - National Concrete Masonry Association; www.ncma.org.
144. NEBB - National Environmental Balancing Bureau; www.nebb.org.
145. NECA - National Electrical Contractors Association; www.necanet.org.
146. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
147. NEMA - National Electrical Manufacturers Association; www.nema.org.
148. NETA - InterNational Electrical Testing Association; www.netaworld.org.
149. NFHS - National Federation of State High School Associations; www.nfhs.org.
150. NFPA - National Fire Protection Association; www.nfpa.org.
151. NFPA - NFPA International; (See NFPA).
152. NFRC - National Fenestration Rating Council; www.nfrc.org.
153. NGA - National Glass Association (The); (Formerly: Glass Association of North America); www.glass.org.
154. NHLA - National Hardwood Lumber Association; www.nhla.com.
155. NLGA - National Lumber Grades Authority; www.nlga.org.
156. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
157. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
158. NRCA - National Roofing Contractors Association; www.nrca.net.
159. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
160. NSF - NSF International; www.nsf.org.
161. NSI - National Stone Institute; (Formerly: Marble Institute of America); www.naturalstoneinstitute.org.
162. NSPE - National Society of Professional Engineers; www.nspe.org.
163. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
164. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
165. NWFA - National Wood Flooring Association; www.nwfa.org.
166. NWRA - National Waste & Recycling Association; www.wasterecycling.org
167. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
168. PDI - Plumbing & Drainage Institute; www.pdionline.org.
169. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
170. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
171. RFCI - Resilient Floor Covering Institute; www.rfci.com.
172. RIS - Redwood Inspection Service; www.redwoodinspection.com.
173. SAE - SAE International; www.sae.org.
174. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
175. SDI - Steel Deck Institute; www.sdi.org.
176. SDI - Steel Door Institute; www.steeldoor.org.
177. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
178. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
179. SIA - Security Industry Association; www.siaonline.org.
180. SJI - Steel Joist Institute; www.steeljoist.org.
181. SMA - Screen Manufacturers Association; www.smainfo.org.
182. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
183. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
184. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
185. SPIB - Southern Pine Inspection Bureau; www.spib.org.
186. SPRI - Single Ply Roofing Industry; www.spri.org.
187. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
188. SSINA - Specialty Steel Industry of North America; www.ssina.com.

189. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
190. STI - Steel Tank Institute; www.steeltank.com.
191. SWI - Steel Window Institute; www.steelwindows.com.
192. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
193. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
194. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
195. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
196. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
197. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
198. TMS - The Masonry Society; www.masonrysociety.org.
199. TPI - Truss Plate Institute; www.tpinst.org.
200. TPI - Turfgrass Producers International; www.turfgrasssod.org.
201. TRI - Tile Roofing Institute; www.tileroofing.org.
202. UL - Underwriters Laboratories Inc.; www.ul.com.
203. UL LLC - UL LLC; www.ul.com.
204. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
205. USAV - USA Volleyball; www.usavolleyball.org.
206. USGBC - U.S. Green Building Council; www.usgbc.org.
207. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
208. WA - Wallcoverings Association; www.wallcoverings.org.
209. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
210. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
211. WDMA - Window & Door Manufacturers Association; www.wdma.com.
212. WI - Woodwork Institute; www.wicnet.org.
213. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
214. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.

11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Room mockups.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For room mockups.

1. Include plans, elevations, sections, and details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

1.4 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.

4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:

1. Notify Architectseven days in advance of the dates and times when mockups will be constructed.
2. Notify Architect14 days in advance of the dates and times when mockups will be tested.
3. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 ROOM MOCKUPS

A. Build room mockups according to approved mockup Shop Drawings to evaluate constructability, demonstrate the coordination of trades and sequencing of Work, and to demonstrate aesthetic requirements. Include each visible finish, component, and equipment item within room mockups; include operable lighting.

B. Provide room mockups of the following rooms:

1. Patient care room.

C. The Work of room mockups includes, but is not limited to, the following:

1. Millwork and casework.
2. Doors and frames.
3. Glazing.
4. Metal framing.
5. Gypsum board.
6. Ceramic tiling.
7. Acoustical ceilings.
8. Resilient flooring.
9. Painting.

10. Wiring devices.
11. Lighting.

PART 3 - EXECUTION

END OF SECTION 014339

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

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

1.3 USE CHARGES

A. 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, occupants of Project, testing agencies, and authorities having jurisdiction.

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

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

1.4 INFORMATIONAL SUBMITTALS

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

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

1.5 QUALITY ASSURANCE

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

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

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

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

2.2 TEMPORARY FACILITIES

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

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

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

1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

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

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

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.

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

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.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

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

3.3 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. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and 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.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

D. 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.

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

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.

    a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

G. 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.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one land-based telephone line(s) for each field office.

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

    a. Police and fire departments.
    b. Ambulance service.

c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. 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. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Storage and Staging: Use designated areas of Project site for storage and staging needs.

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

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

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

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

G. 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.

H. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.

2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

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

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

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 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. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.

6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

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

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

3.6 MOISTURE AND MOLD CONTROL

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

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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. 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

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.
2. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

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

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

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

1.4 ACTION SUBMITTALS

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

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

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

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

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

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

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

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

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

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

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

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a. Restricted List: 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 not be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

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

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

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

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

2.2 COMPARABLE PRODUCTS

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

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

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

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

1.4 QUALITY ASSURANCE

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

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural 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. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Mechanical systems piping and ducts.
    f. Control systems.
    g. Communication systems.
    h. Fire-detection and -alarm systems.
    i. Conveying systems.
    j. Electrical wiring systems.
    k. Operating systems of special construction.

3. 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 products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

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

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

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

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

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

B. 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.

C. Use of Indelible Paints and Ink

1. Use of indelible paint and ink for layout indicators on exposed concrete surfaces is prohibited. Use only removable marking products, if any, on exposed concrete surfaces.

3.4 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

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

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

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

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

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

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

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

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

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

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

3.5 CUTTING AND PATCHING

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

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

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

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

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

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in 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. Provide materials and comply with installation requirements specified in other Sections, where applicable.

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

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

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

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

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

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

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

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

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

3.7 STARTING AND ADJUSTING

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

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

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

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

3.8 PROTECTION OF INSTALLED CONSTRUCTION

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

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

END OF SECTION

SECTION 017419.01 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Recycling nonhazardous construction waste.
2. Disposing of nonhazardous construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 PERFORMANCE REQUIREMENTS

A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling of materials including the following:

1. Construction Waste:

a. Packaging: Salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic pails.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
2. Review waste management requirements for each trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:

1. ReSource Fort Collins, 1501 N. College Ave., Fort Collins, CO 80524, 970-498-9663, www.resourceftcollins.org.
2. Diversion Connection, (720) 341-2259.
3. Boulder Hauling, PO Box 18113, Boulder, CO 80308, 303-447-8930, www.boulderhauling.com.
4. 1-800-GOT-JUNK?, 1410 S. Foothills Hwy, No. 3, Boulder, CO, www.1800gotjunk.com.
5. Western Disposal, 5880 Butte Mill Rd., Boulder, CO 80301, 303-444-2037.
6. Fort Collins Habitat for Humanity Restore, 4001 S Taft Hill Rd., Fort Collins, CO 80526, 970-223-9909.
7. Habitat for Humanity ReStore, 1351 Sherman Dr., Longmont, CO 80501, 303-776-3334, www.stvrainhfh.org.
8. Organics Supply, 15121 Weld Co. Rd. 32, Plattville, CO 80651, 303-659-6003.
9. Habitat for Humanity of Pueblo ReStore, 2313 S. Prairie Ave., Pueblo, CO 81005, 719-543-0702.
10. Pikes Peak Habitat for Humanity, 411 S. Wahsatch Ave., Colorado Springs, CO 80903, 719-667-0840.
11. Five Star Disposal, 1326 S. La Crosse Ave., Pueblo, CO 81001, 888-681-7481.
12. Junk King Colorado Springs, 8680 Shoup Rd., Colorado Springs, CO 80908, 719-694-5250.
13. Arwood Waste of Colorado Springs, 1965 Commercial Blvd., Colorado Springs, CO 80906, 719-359-8863.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

D. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

E. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Store components off the ground and protect from the weather.
3. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.2 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site.

3.3 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419.01

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 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.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 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 Owner . Label with manufacturer's name and model number.

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

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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 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.
5. Submit Final Completion photographic documentation.

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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 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. PDF Electronic File: Architect will return annotated file.

1.10 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. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

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

D. 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.

E. 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 paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

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

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

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. 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.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.

r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

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

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Systems and equipment operation manuals.
2. Systems and equipment maintenance manuals.
3. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 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 electronic PDFs uploaded to web based project software site.
2. Provide as follows:

a. Enable reviewer comments on draft submittals.
b. Enable documents so that text is searchable.

c. Provide Bookmarks to improve navigation.

C. Initial Manual Submittal: Submit at minimum, a Cover and Table-of-Contents for each manual at least 30 calendar days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 calendar 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.

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

1.5 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.

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

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

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

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

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.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

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.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

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

D. 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.

E. 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.

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

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. 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.

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

I. 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.

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

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

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

D. 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.

E. 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.

F. Repair Materials and Sources: Include lists of materials and local sources of 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for general closeout procedures.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

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

a. Initial Submittal:

1) Submit one (1) of the following for review:

a) One (1) paper-copy set of marked-up record prints.
b) PDF electronic file of scanned record prints.
c) PDF electronic file of marked-up record file.

2) Architect will indicate whether general scope of changes, additional information recorded, and quality of documentation are acceptable.

b. Final Submittal:

1) Submit one of the following:

a) PDF electronic file of scanned record prints.
b) PDF electronic file of marked-up record file.

2) Submit one (1) set set(s) of hardcopy prints from the electronic file.

3) Print each drawing, whether or not changes and additional information were recorded.

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

1.4 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 PDF Electronic File of Marked-up Record File: An electronic version of the Record Prints described above and with similar preparation and content may be provided as a Record Drawing instead of a marked-up paper copy.

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.
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.

1.5 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 and Record Drawings where applicable.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1.3 QUALITY ASSURANCE

A. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

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, as required by individual Specification Sections.

1. Equipment, including food-service equipment and residential appliances.

2. Fire-protection systems, including fire alarm, fire pumps, and fire-extinguishing systems.
3. Heat generation ,including boilers, pumps and water distribution piping.
4. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
5. HVAC systems, including air-handling equipment, air distribution systems, and terminal equipment and devices.
6. HVAC instrumentation and controls.
7. Electrical service and distribution, including transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
8. Lighting equipment and controls.

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.

1. Owner will furnish Contractor with names and positions of participants.

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

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

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

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 013513 "Alteration Project Procedures" for special procedures for alteration work.
3. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

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

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

1.4 MATERIALS OWNERSHIP

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

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

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

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

B. Post-Demolition Field-Walk: Schedule and conduct a post-demolition field-walk of existing conditions.

1. After demolition of ceilings and walls, conduct a field-walk to identify and address any latent defects or unforseen conditions, including but not limited to the following:

   a. Existing fire-ratings voided by previous work.
   b. Existing overhead plumbing/mechanical that may be in conflict with proposed new ceiling heights.
   c. Other existing conditions.

2. Attendees: Contractor, Owner, Architect, and Consultants as needed.
3. Schedule: Conduct field-walk as soon as possible, but not less than two-weeks prior to the start date for new work within the existing area(s).

1.6 INFORMATIONAL SUBMITTALS

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

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

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

D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 FIELD CONDITIONS

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

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

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

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

1. 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.

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

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

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

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

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

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated 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.

3.3 PREPARATION

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

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

3.4 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Luminaires:

1. Disconnect, remove, and store, at the job site, in an indoor dry location, luminaires scheduled for reuse by Owner, that have been previously determined to not contain PCB fluorescent ballasts, until such time as they are ready to be installed.

    a. Existing lamps shall not be reused regardless of whether or not the existing luminaire is scheduled for reuse. Existing lamps shall be legally disposed of, and reused luminaires shall be re-lamped with new lamps.

2. Move luminaires that have been previously determined to not contain PCB Fluorescent ballasts, and that are scheduled for disconnection and removal, and are not scheduled for reuse or reinstallation, to an on-site location, as directed by the Owner. Moved luminaires shall remain the property of the Owner.

    a. Remove lamps from luminaires, and store separately at an on-site location, as directed by the owner.

3. Remove from the site, and legally dispose of disconnected and removed luminaires, that have been previously determined to not contain PCB fluorescent ballasts, and that the Owner does not wish to retain.

    a. Remove lamps from luminaires and disposed of separately.

4. Do not use existing luminaires that have been determined to contain integral or remote mounted PCB fluorescent ballasts, either known, or determined by field survey and investigation.

    a. Disconnect and remove the PCB containing fluorescent ballast(s), if the ballast(s) is not leaking, per the ballast disposal requirements written herein, and replace with a new non-PCB replacement ballast.
    b. Notify the project owner if the PCB-containing ballast is leaking, and proceed no further. The luminaire is considered contaminated and hazardous. Removal of the luminaire shall be the responsibility of the Owner.

5. Do not remove or re-use existing luminaires installed in project spaces being abated for asbestos. Luminaires installed in project spaces being abated for asbestos shall be considered hazardous material and as such shall be removed as part of any abatement process.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

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

END OF SECTION 024119

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 099123 "Interior Painting" for concrete floor sealers.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

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

2. Sulfate Resistance: When sulfate concerns are indicated in the geotechnical report, for concrete in contact with soil, provide Portland Cement C 150 Type I/II Modified Cement tested to meet type V for sulfate resistance per ASTM C150 Table 4 and ASTM C452. Provide a tricalcium aluminate content of not more than 8 percent.
3. Fly Ash: ASTM C 618, Class F or C.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

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

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A, minimum 15 mils thickness, except with maximum water-vapor permeance of 0.01 perms. Include manufacturer's recommended adhesive or pressure-sensitive tape, adhesive, mastic, and prefabricated boots for sealing seams and penetrations in vapor retarder.

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

a. Fortifiber Building Systems Group; Moistop Ultra 15.
b. Insulation Solutions, Inc.; Viper VaporCheck II 15 mil.
c. Meadows, W. R., Inc.; Perminator 15 mil.
d. Raven Industries Inc.; Vaporblock VB15.
e. Reef Industries, Inc.; Griffolyn 15 mil Green.
f. Stego Industries, LLC; Stego Wrap 15 mil Class A.
g. Poly-America; Husky Yellow Guard 15 mil Class A.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Water: Potable.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing , and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
2. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:.

1. Fly Ash: Maximum 20 percent, except as otherwise noted.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi at 28 days .
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent for 3/4 inch nominal maximum aggregate size, at point of delivery.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

B. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 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, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

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. Fine grade under slab soils to smooth and level surface prior to installation of slab on grade edge and construction joint forms.
2. Tamp and level subbase materials to within plus zero (0) inches to minuse 3/4 inches from required subgrade elevation.
3. Seal to perimeter as indicated on Drawings or, if not indicated, by turning vapor-retarder up the foundation wall to seal between the poured concrete and foundation, or with manufacturer's standard mechanical bond tape to form a mechanical bond to the underside of the slab perimeter.
4. Seal all penetrations, including pipes, with manufacturer's standard prefabricated boots or other manufacturer's standard detail.
5. No penetrations of vapor retarder membrane are permitted except for reinforcing steel and permanent utilities.
6. Do not disturb or damage vapor retarder while placing concrete. Repair damaged vapor retarder by cutting patches of vapor retarder, overlapping damaged area 6 inches minimum and taping all four sides with seal 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.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.4 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.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- 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.

1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.5 CONCRETE PLACEMENT

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

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.6 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.7 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

3.8 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

END OF SECTION 033000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for countertops.
3. Steel tube reinforcement for low partitions.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Miscellaneous steel trim including steel angle corner guards steel edgings and loading-dock edge angles.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 012300 "Alternates" for alternates related to metal fabrications.
2. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
3. Section 099123 "Interior Painting" for priming and painting requirements for interior metal fabrications.
4. Section 102600 "Wall and Door Protection" for interior stainless steel corner guards.

1.3 COORDINATION

A. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Primer and paint products.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for countertops.
3. Steel tube reinforcement for low partitions.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Miscellaneous steel trim .

C. Delegated-Design Submittal: For ladders and equipment support systems using cold-formed adjustable metal framing and hot-rolled steel section supports (unistrut), including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 FABRICATORS

A. Fabricators: Subject to compliance with requirements, available fabricators offering services that may be incorporated into the Work include, but are not limited to, the following:

1. Western Slope Iron and Supply, Inc, Grand Junction, CO, 970-243-9770, www.wsiron.com.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders and equipment support systems using cold-formed adjustable metal framing and hot-rolled steel section supports (unistrut).

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.
2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts (Weathering): Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

A. Low-Emitting Paints and Coatings: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

B. Shop Primers: Provide primers that comply with Section 099123 Interior Painting" for interior metal fabrications, and Section 099600 "High-Performance Coatings" for exterior metal fabrications.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime exposed miscellaneous framing and supports with primer specified in Section 099123 "Interior Painting" for interior locations and 099600 "High-Performance Coatings" for exterior locations.

2.8 COUNTERTOP SUPPORTS, MANUFACTURED

A. Manufacturers:

1. Basis-of-Design: Subject to compliance with requirements, provide counter support brackets indicated below, or approved substitution.

a. Concealed brackets:

1) Rakks EH-1818FM for countertops up to 25 inches deep.
2) Rakks EH-1824FM for countertops up to 30 inches deep.
3) Locations: Typical at all countertops without base cabinets, except as noted.

b. Material: Aluminum.
c. Extrusion: "T" Shape.
d. Weight Capacity: 300 lb minimum.
e. Finish: Primed for field painting.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.10 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

A. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

B. Shop prime iron and steel items unless they are to be embedded in concrete, to receive sprayed-on fireproofing, installed against masonry, or unless otherwise indicated.

1. Shop prime exposed interior metal fabrications with primers specified in Section 099123 "Interior Painting" unless otherwise noted.

2. Shop prime exposed exterior metal fabrications with primers specified in Section 099600 "High Performance Coatings" unless otherwise noted.

3. Shop prime metal fabrications with zinc-rich primer where indicated, and where metal fabrications are concealed behind framing that is outside the building air barrier.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for securely to, and rigidly brace from, building structure.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Plywood backing panels.
3. Plywood blocking and nailers.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review (NGLA, WWPA,NeLMA, SPIB, etc.) to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

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 except as otherwise noted:

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, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Plywood backing panels.
2. Plywood, blocking, and nailers within exterior walls and exterior openings.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking and nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:.

1. Hem-fir.
2. Douglas-fir.

C. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 PLYWOOD BLOCKING AND NAILERS

A. Plywood Blocking and Nailers: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than thickness as indicated on Drawings nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002 and ASTM C 954, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 , ICC-ES AC58 , ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.

3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B; G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

2.9 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.

1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the 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."

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. 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.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

A. Protect 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.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

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SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates related to PLAM cabinets.
2. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
3. Section 092216 "Non-Structural Metal Framing" for metal backing required for installing cabinets and concealed within other construction before cabinet installation.
4. Section 123623.13 "Plastic-Laminate-Clad Countertops."
5. Section 123661.16 "Solid Surfacing Countertops."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each color, pattern, and surface finish.
2. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance..

B. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Fabricators: Subject to compliance with requirements, available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Concepts in Millwork Inc., 1490 Tuskegee Place, Colorado Springs, CO 80915, 719-570-7353.
2. E & J Cabinets, 6110 West 55th Avenue, Arvada, CO 80002, 303-4257527
3. JK Concepts, Inc., 3333 East 52nd Avenue, Denver, CO 80216, 303-571-0672.
4. LA Woodworks, 4476 Bents Drive, Windsor, CO 80550, 970-482-4200.
5. MGC, Inc., 2061 Cheyenne Summer View, Colorado Springs, CO, 80904, 719-358-7436.
6. Sidney Millwork Company, 1166 Cambrian Lane, Sidney, MT 59270, 406-482-2810.
7. Unique Woodworking, 2605 West 7th Avenue, Denver, CO 80204, 303-573-3966.
8. Wood Designs Limited, 2438 6th Avenue, Greeley, Colorado, 80631, 970-356-0339, www.wooddesignsltd.com.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay .

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Basis-of-Design: Subject to compliance with requirements provide products indicated on Drawings or approved substitution from the following:

a. Formica Corporation.
b. Lamin-Art, Inc.
c. Panolam Industries International, Inc (Nevamar, Pionite).
d. Wilsonart International; Div. of Premark International, Inc.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.
4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.

a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.

b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
c. Balanced Construction: For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated on Drawings.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

C. Low-Emitting Composite Wood: Provide materials/products that have low formaldehyde emissions that meet the California Air Resources Board (CARB) ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

D. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

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

1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
2) Sorm Incorporated; Primeboard Premium Wheat.

4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 120 degrees of opening.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Shelf Rests: BHMA A156.9, B04013; plastic, two-pin type with shelf hold-down clip.

E. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
5. For drawers more than 6 inches high or more than 24 incheswide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches high and 16 incheswide, provide Grade 1HD-100.

F. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

G. Door and Drawer Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.

1. Provide a single master key system for all new locks.

2. Provide a minimum of two keys per lock and two master keys.
3. Provide locks on all doors and drawers.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

I. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick unless otherwise indicated.

J. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

B. Metal Reveals: Continuous extruded aluminum reveal set into face of cabinetry where indicated.

1. Basis-of-Design: Subject to compliance with requirements provide product indicated on Drawings or comparable product by another manufacturer.
2. Finish: Selected by Architect from manufacturer's full range of standard finishes.

C. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

D. Adhesives: Do not use adhesives that contain urea formaldehyde.

E. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips,or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ACTION SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

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 its "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grace Construction Products.
2. Hilti, Inc.
3. Johns Manville.
4. 3M Fire Protection Products.
5. Tremco, Inc.; Tremco Fire Protection Systems Group.
6. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Fire-resistance-rated walls include wall assemblies as indicated on Drawings.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Polysulfide joint sealants.
7. Butyl joint sealants.
8. Latex joint sealants.
9. Joint sealants in exterior decorative concrete paving.
10. Joint sealants in exterior plazas and decks.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review exterior materials and proposed sealants.
2. Review color selections.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant designation.

a. Use same designation as indicated in the Schedule at the end of this Section.

2. Joint-sealant application and joint location.
3. Joint-sealant manufacturer and product name.
4. Joint-sealant formulation.
5. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

B. Field-Adhesion-Test Reports: For each sealant application tested.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 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.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

D. 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.

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

a. GE Construction Sealants; SCS2700 SilPruf LM.
b. Sika Corporation U.S.; Sikasil WS-290 FPS.

B. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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

a. Dow Corning Corporation; 758.
b. Polymeric Systems, Inc.; PSI-641.

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.

1. Products: Subject to compliance with requirements, provide the following or approved substitution:

a. Dupont (formerly Dow); DowSil 790.
b. Pecora Corporation; 890 FTS (field-tintable sealant).

2.4 URETHANE JOINT SEALANTS

A. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.

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

a. Pecora Corporation; Dynatrol II.

B. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.

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

a. LymTal International, Inc.; Iso-Flex 888QC.

C. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.

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

a. Pecora Corporation; Dynatrol II SG.

2.5 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C 1247, Class 2; tested in deionized water unless otherwise indicated

B. Urethane, Immersible, M, P, 25, T, NT, I: Immersible, multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T, NT, and I.

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

a. BASF Construction Chemicals - Building Systems; Sonolastic SL 2.
b. LymTal International, Inc.; Iso-Flex 880 GB.
c. Sika Corporation U.S.; Sikaflex 2c SL.

2.6 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.

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

a. Dow Corning Corporation; 786-M White.
b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
c. Soudal USA; RTV GP.
d. Tremco Incorporated; Tremsil 200.

2.7 POLYSULFIDE JOINT SEALANTS

A. Polysulfide, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, polysulfide joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.

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

a. W.R. Meadows, Inc.; Deck-O-Seal 125.

2.8 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

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

a. Bostik, Inc.; Chem-Calk 300.
b. Pecora Corporation; BC-158.

2.9 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

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

a. BASF Construction Chemicals - Building Systems; Sonolac.
b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; .
c. Pecora Corporation; AC-20.
d. Tremco Incorporated; Tremflex 834.

2.10 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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 Construction Chemicals - Building Systems.
b. Construction Foam Products, a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) except as noted, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance, typically 1.5 times the joint size.

1. Basis-of-Design: Subject to compliance with requirements, provide the following, or comparable product:

a. SOF-Rod Bi-Cellular Polyethylene Backer Rod.

2. At dual-line installations, provide Type O open-cell material at the in-board (primary) seal, to allow sealant out-gassing to pass through the backer rod.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.11 MISCELLANEOUS MATERIALS

A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

B. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.
b. Masonry.
c. Unglazed surfaces of ceramic tile.
d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 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 5 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    b. Perform one test for each 1000 feet 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.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant JS-1:

1. Application: Exterior joints in horizontal traffic surfaces.
2. Locations:

    a. Expansion joint between paving and building exterior.
    b. Isolation and contraction joints in cast-in-place concrete slabs.
    c. Joints between plant-precast architectural concrete paving units.
    d. Tile control and expansion joints.
    e. Joints between different materials listed above.
    f. Other joints as indicated on Drawings.

3. Formulation: Urethane, M, P, 50, T, NT.
4. Color:As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant JS-2:

1. Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
2. Locations:

    a. Joints in pedestrian plazas.
    b. Joints in swimming pool decks.
    c. Other joints as indicated on Drawings.

3. Formulation: Urethane, immersible, M, P, 25, T, NT, I.
4. Color:As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant JS-3:

1. Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
2. Locations:

    a. Construction joints in cast-in-place concrete.
    b. Joints between plant-precast architectural concrete units.
    c. Control and expansion joints in unit masonry.
    d. Joints in dimension stone cladding and anchored stone masonry veneer.
    e. Joints in glass unit masonry assemblies.
    f. Joints in exterior insulation and finish systems.
    g. Joints between metal panels.
    h. Joints between different materials listed above.

i. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
j. Control and expansion joints in ceilings and other overhead surfaces.
k. Other joints as indicated on Drawings.

3. Formuation: Silicone, nonstaining, S, NS, 100/50, NT.
4. Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant JS-4:

1. Application: Interior joints in horizontal traffic surfaces.
2. Locations:

a. Isolation joints in exposed cast-in-place concrete slabs.
b. Control and expansion joints in stone flooring.
c. Control and expansion joints in brick flooring.
d. Control and expansion joints in tile flooring.
e. Other joints as indicated on Drawings.

3. Formulation: Urethane, M, P, 25, T, NT, or Polysulfide M, P, 25, T, NT.
4. Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant JS-5:

1. Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
2. 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.
d. Joints on underside of plant-precast structural concrete beams and planks.
e. Other joints as indicated on Drawings.

3. Formulation: Urethane, M, NS, 50, NT.
4. Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant JS-6:

1. Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
2. Locations:

a. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
b. Other joints as indicated on Drawings.

3. Formulation: Acrylic latex.
4. Color:As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant JS-7:

1. Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
2. Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

3. Formulation: Silicone, mildew resistant, acid curing, S, NS, 25, NT .
4. Color: As selected by Architect from manufacturer's full range of colors.

H. Joint-Sealant JS-8:

1. Application: Concealed mastics.
2. Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

3. Formulation: Butyl-rubber based.
4. Color: Manufacturer's standard color.

END OF SECTION

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Acoustical joint sealants.
2. Smoke and acoustic spray.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.3 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Acoustical-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.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by a qualified testing agency.

B. Sample Warranties: For special warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical 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 acoustical 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 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

1. Sealant shall have a VOC content of 250 g/L or less.

B. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

2.2 ACOUSTICAL JOINT SEALANTS, AJS-1

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.

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

a. Hilti; CP 506 Smoke and Acoustic Sealant.
b. Pecora Corporation; AC-20 FTR.
c. Tremco, Incorporated; Tremco Acoustical Sealant.
d. USG Corporation; SHEETROCK Acoustical Sealant.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.3 SMOKE AND ACOUSTIC SPRAY, SJS-1

A. Spray-applied for sealing construction joint openings in non-fire-rated acoustical barriers and smoke partitions.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hilti CP 572 or approved substitution.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

1. Low-Emitting Paints and Coatings: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates related to hollow metal doors and frames.
2. Section 081416 "Flush Wood Doors" for solid core wood doors installed in hollow-metal frames.
3. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
4. Section 099123 "Interior Painting" for field painting of interior hollow-metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware, including high-frequency hinge preparations.
5. Details of each different wall opening condition.

6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Mesker Door Inc.
4. Republic Doors and Frames.
5. Rocky Mountain Metals, Inc.
6. Southwestern Hollow Metal Co.
7. Steelcraft; an Ingersoll-Rand company.
8. West Central Mfg. Inc.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (18 gauge).
    d. Edge Construction: Model 2, Seamless.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (16 gauge).
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 BORROWED LITES

A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.053 inch(16 gauge).

B. Construction: Full profile welded.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 088000 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

1. Low-Emitting Paints and Coatings: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
3. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
4. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
7. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate u to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware." Wire nut connections are not acceptable.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

    c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

8. Electrical Thru-Wiring: Provide holllow metal frames receiving electrified hardware with loose wiring harness (not attached to open throat components or installed in closed mullion tubes) and standardized Molex plug connectors on one end to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electric through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware and "Access Control Hardware."
9. Electrical Knock- Out Boxes: Factory weld 18 gauge electrical knock-out boxes to frame for electrical hardware preps including but not limited to; electric through-wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in hardware sets in Division 08 Sections "Door Hatdware" and "Access Control Hardware."

    a. Provide electrical knock-out boxes with dual 1/2 inch and 3/4 inch knockouts.
    b. Conduit to be coordinated and installed in the field (Division26) from middle hinge box and strike box to door position box.
    c. Electrical knock-out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section "Door Hardware."

d. Electrical knock-out boxes for continuous hinges should be located in the center of the vertical dimension of the hinge jamb.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. High Frequency Hinge Preparations for Frames:

1. Provide auxiliary welded reinforcement at the top hinge of door frame to prevent potential door sag, as described in SDI-111-09.
2. Locations: Provide at all main entrance doors, rear exit doors, auditoriums, cafeterias, and gymnasiums.

G. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

a. Low-Emitting Paints and Coatings: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

2.9 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
    d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is a licensee of WI's Certified Compliance Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door onbottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASSA ABLOY Wood Doors (GR): GPD Series.
2. Eggers Industries.
3. Marshfield-Algoma (MF): Aspiro Series.
4. Oshkosh Door Company.
5. VT Industries, Inc.(VT): Heritage Collection.

B. Source Limitations: Obtain flush wood doorsfrom single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

B. WDMA I.S.1-A Performance Grade:

1. Extra Heavy Duty unless otherwise indicated.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

E. Particleboard-Core Doors:

1. Composite Wood Products: Products shall be made without urea formaldehyde.

2. Low-Emitting Composite Wood: Provide materials/products that have low formaldehyde emissions that meet the California Air Resources Board (CARB) ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.
3. Particleboard: ANSI A208.1, Grade LD-2.
4. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except for density.
5. Blocking: Provide wood blocking in particleboard-core doors as follows:

a. 5-inch top-rail blocking, in doors indicated to have closers.
b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.

6. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

F. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf.
b. Screw Withdrawal, Edge: 400 lbf.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors :

1. Grade: Premium, with Grade A faces.
2. Species: Match existing doors**.**
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Running match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
8. Core: Particleboard, except use structural composite lumber for half-lite and full-lite doors.
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: M1 Flush Bead.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Louvers:

1. Blade Type: Vision-proof, inverted Y.
2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

D. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.

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. Air Louvers Inc.
b. Anemostat; a Mestek company.
c. L & L Louvers, Inc.
d. Louvers & Dampers, Inc.; a Mestek company.
e. McGill Architectural Products.

2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

2.5 ELECTRICAL RACEWAYS

A. Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve (12) wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in Section 087100 "Door Hardware." Wire nut connections are not acceptable.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted onbottom edges, edges of cutouts, and mortises.

B. Factory finish doors that are indicated to receive transparent finish.

C. Transparent Finish:

1. Low-Emitting Paints and Coatings: Provide products that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.
2. Grade: Custom.
3. Finish: WDMA TR-8/AWS System 9, UV Cured Acrylated Polyurethane.
4. Staining: None required.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:

1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames
3. Division 8: Hollow Metal Doors and Frames.
4. Division 8: Wood Doors.
5. Division 26 Electrical
6. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80 -Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
8. ICC – International Building Code

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances

1. Refer to Division 1 for allowance amount and procedures.

F. Alternates

1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

    a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
    b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

    a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
    b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Thirty years
2. Exit Devices: Five Years
3. Locksets & Cylinders: Three years
4. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Item:	Manufacturer:
Hinges	Stanley
Continuous Hinges	Stanley
Locksets	Best
Cylinders	Best
Exit Devices	Precision
Electric Strikes	H.E.S.
Closers	Stanley
Access Control System	by Owners Security Integrator
Low Energy Operators	Stanley
Push/Pull Plates	Trimco
Push/Pull Bars	Trimco
Protection Plates	Trimco

Overhead Stops	ABH
Door Stops	Trimco
Flush Bolts	Trimco
Coordinator & Brackets	Trimco
Threshold & Gasketing	National Guard

2.2 MATERIALS:

A. Hinges: Shall be Five Knuckle Ball bearing hinges

1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings
12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
15. UL10C listed for Fire rated doors.

B. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

C. Electrified Functions for Hinges: Comply with the following:
1. Power Transfer: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle. Provide wire quantity and sizes required for electric hardware be served.
2. Monitoring: Concealed electrical monitoring switch.
3. Power Transfer and Monitoring: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle, and with concealed electrical monitoring switch.

D. Cylindrical Type Locks and Latchsets:

1. Tested and approved by BHMA for ANSI A156.2, Series 4000, Operational Grade 1, Extra-Heavy Duty, and be UL10C listed.
2. Provide 9001-Quality Management and 14001-Environmental Management.
3. Fit modified ANSI A115.2 door preparation.

4. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
5. Locksets to have anti-rotational studs that are thru-bolted
6. Keyed lever shall not have exposed “keeper” hole
7. Each lever to have independent spring mechanism controlling it
8. 2-3/4 inch (70 mm) backset
9. 9/16 inch (14 mm) throw latchbolt
10. Provide sufficient curved strike lip to protect door trim
11. Outside lever sleeve to be seamless, of one-piece construction made of a hardened steel alloy
12. Keyed lever to be removable only after core is removed, by authorized control key
13. Provide locksets with 7-pin removable and interchangeable core cylinders
14. Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
15. Locksets outside locked lever must withstand minimum 1400 inch pounds of torque. In excess of that, a replaceable part will shear. Key from outside and inside lever will still operate lockset.
16. Core face must be the same finish as the lockset.
17. Functions and design as indicated in the hardware groups.

E. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1
2. Provide 9001-Quality Management and 14001-Environmental Management.
3. Furnish UL or recognized independent laboratory certified mechanical operational testing to 10 million cycles minimum.
4. Provide a deadlocking latchbolt
5. Non-fire rated exit devices shall have cylinder dogging.
6. Touchpad shall be “T” style
7. Exposed components shall be of architectural metals and finishes.
8. Lever design shall match lockset lever design
9. Provide strikes as required by application.
10. Fire exit devices to be listed for UL10C
11. UL listed for Accident Hazard
12. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
13. Provide vandal resistant or breakaway trim
14. Aluminum vertical rod assemblies are acceptable only when provide with the manufacturers optional top and bottom stainless steel rod guard protectors.

F. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

G. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck

8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1½“ minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.

H. Low Energy Operators shall:

1. Conform to ANSI/BHMA A156.19 as a low energy power opening device.
2. Be listed under UL228, UL325, UL10B, UL10C, UBC 7.2 and FCC listed.
3. Shall be non-handed.
4. Be rated for door panels weighing up to 350 lbs (160 kg).
5. The manual door closer within the Low Energy Operator shall be adjusted to meet Americans with Disabilities Act (ADA) 5 lbs opening force [Push-Side applications only]
6. Operator shall be isolated from mounting plate with rubber mounts to mitigate the transmission of forces between the door and the operator.
7. Shall have a position encoder to communicate with microprocessor.
8. Incorporate a resetable powered operation counter that tracts both powered and non-powered cycling of the Operator.
9. Incorporate the following adjustable settings:
    a. Hold Open Timer, to 28 seconds
    b. Open Speed
    c. Backcheck Spped
    d. Vestibule Sequence Timer
10. Include DIP switch controls for:
    a. On board diagnostics
    b. Power close
    c. Push and Go operation
    d. Time delay logic for electrified hardware components
11. Include terminals for auxiliary controls including:
    a. Activation devices, provide two discrete inputs
    b. Vestibule sequencing
12. Control switches including:
    a. Day/Night open (illuminated)
    b. Power On-Off
13. Includes adhesive Low Energy Operator mounting templates.
14. R-14 Aluminum Allow Materials
15. For non-powered operation, the unit shall function as a standard door closer with adjustable spring force size 1 thru 6.

I. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

J. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

K. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

L. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

M. Door Bolts: Flush bolts for wood or metal doors.

1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.

N. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.

1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
2. Provide mounting brackets for soffit applied hardware.
3. Provide hardware preparation (cutouts) for latches as necessary.

O. Power Supply: UL Listed, Field Selectable 12VDC or 24VDC output. The power supply will specifically designed to support electric locks and access controls. The power supply uses 115 VAC at 800mA input. The power shall be able to be expanded to four station controls. The filtered and regulated output power is field selectable for 12 or 24 VDC.

1. Fire Alarm/Life Safety emergency release included in power supply.
2. Available options for multiple door options four or more control stations, Adjustable Time delay relay, Battery charging, Battery Back up.

P. Electric Door Strike: Certified by ANSI/BHMA 156.31, Grade 1. and listed for Burglary Protection ANSI/ UL1034 Grade 1.

1. For General use provide fail-secure electric strike and with fire-rated device.
2. Listed UL10C for Fire Door assemblies
3. Latchbolt monitor switch option when specified in hardware sets.
4. Provide the electric strike in the appropriate model that will accept a 5/8” or 3/4" latchbolt.

Q. Door Position Switch: Provide door position switch for door status monitoring as indicated in hardware sets.

1. At all fired rated doors the door and frames, position switch preparation will be provided by the door and frame manufacturer or by an authorized label service agent.

R. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

S. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

T. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

U. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½" for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

2. Recommended locations for Architectural Hardware for flush wood doors (DHI).

3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

a. Verify levers are free from binding.
b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

Manufacturer List

Code	Name
AB	ABH Manufacturing Inc.
BE	Best Access Systems
BY	By Others
HS	H.E.S.
PR	Precision
NA	National Guard
RC	RCI
ST	Stanley
TR	Trimco

Finish List

Code	Description
32D	Satin Stainless Steel
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
US26D	Chromium Plated, Dull
US32D	Stainless Steel, Dull
Silver	Silver

Option List

Code	Description
LB	Less Bottom Rod
CSK	Counter Sunk Screw Holes
MLR	Motorized Latch Retraction
LM/MS	Latch & Touchbar Monitor
B4E	Beveled 4 Edges

HARDWARE SETS

SET #1.0

Doors: E030

6	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Exit Device	MLR TS 2203 x 4908A LBR	630	PR
1	Exit Device	2201 LBR	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Construction Core	1C-7A-CC Orange		BE
1	Permanent Core	by CMC Facilities Dept.	626	BY
1	Auto Operator	Magic Force LE	628	ST
1	Door Closer Rw/PA	QDC111	689	ST
2	Kick Plate	K0050 10" x 1" LDW B4E CSK	630	TR
2	Wall Bumper	1270CVSV	626	TR
2	Push Button Switch	910TC-WRM-WRB	32D	RC
1	Power Supply	By Security Provider		BY
1	Door Loop	9509-18S	Silver	RC
1	Gasketing	5050B Head & Jambs		NA

NOTE: Existing door/frame to remain. Rework door & frame to except new hardware. Field verify all existing conditions prior to ordering hardware.

SET #2.0

Doors: E019, 048

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Storeroom Lockset	9K3-7D14D L/C	626	BE
1	Permanent Core	by CMC Facilities Dept.	626	BY
1	Construction Core	1C-7A-CC Orange		BE
1	Electric Strike	5000C	32D	HS
1	Door Closer Rw/PA	QDC111	689	ST
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Wall Bumper	1270CVSV	626	TR
1	Power Supply	By Security Provider		BY
1	Card Reader	By Security Provider		BY
1	Gasketing	5050B Head & Jambs		NA

NOTE: Doors are normally closed and locked. Access is gained with valid credentials. Free egress is allowed at all times without use of keys, credentials, special knowledge or effort.

SET #3.0

Doors: 040, 041, 042, 043, 049A, 049B

5	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Electric Hinge	CEFBB179-54 4 1/2 X 4 ½	US26D	ST
1	Storeroom Lockset	9K3-7D14D L/C	626	BE
1	Permanent Core	by CMC Facilities Dept.	626	BY
1	Construction Core	1C-7A-CC Orange		BE
1	Electric Strike	5000C	32D	HS
1	Door Closer Rw/PA	QDC111	689	ST
1	Overhead Stop	4420 Series	US32D	AB
2	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Card Reader	By Security Provider		BY
1	Power Supply	By Security Provider		BY
1	Astragal	158NA		NA
1	Gasketing	5050B Head & Jambs		NA

NOTE: Doors are normally closed and locked. Access is gained with valid credentials. Free egress is allowed at all times without use of keys, credentials, special knowledge or effort.

SET #4.0

Doors: 042A, 042B, 042C, 042D

6	Hinges	FBB179 4 1/2 X 4 ½	US26D	ST
1	Manual Flushbolt	3917-12	626	TR
1	Passage Set	9K3-0N14D	626	BE
1	Door Closer Rw/PA	QDC111	689	ST
1	Overhead Stop	4420 Series	US32D	AB
2	Kick Plate	K0050 10" x 1" LDW B4E CSK	630	TR
2	Wall Bumper	1270CVSV	626	TR
1	Gasketing	5050B Head & Jambs		NA
1	Astragal	158NA		NA

SET #5.0

Doors: 044

6	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Manual Flushbolt	3917-12	626	TR
1	Office/Entry Lockset	9K3-7AB14D L/C	626	BE
1	Permanent Core	by CMC Facilities Dept.	626	BY
1	Construction Core	1C-7A-CC Orange		BE
1	Door Closer Rw/PA	QDC111	689	ST
1	Overhead Stop	4420 Series	US32D	AB
2	Kick Plate	K0050 10" x 1" LDW B4E CSK	630	TR
1	Dome Stop	1211	626	TR
1	Gasketing	5050B Head & Jambs		NA
1	Astragal	158NA		NA

SET #6.0

Doors: 045, 046

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Office/Entry Lockset	9K3-7AB14D L/C	626	BE
1	Permanent Core	by CMC Facilities Dept.	626	BY
1	Construction Core	1C-7A-CC Orange		BE
1	Door Closer Rw/PA	QDC111	689	ST
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Wall Bumper	1270CVSV	626	TR
1	Gasketing	5050B Head & Jambs		NA

SET #7.0

Doors: 042E, 042F

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Office/Entry Lockset	9K3-7AB14D L/C	626	BE
1	Permanent Core	by CMC Facilities Dept.	626	BY
1	Construction Core	1C-7A-CC Orange		BE
1	Door Closer Cush Stop	QDC119	689	ST
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Gasketing	5050B Head & Jambs		NA

END SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, storefront framing.
2. Glazing sealants and accessories.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Fames" for hollow metal doors and frames to receive glazing specified in this Section.
2. Section 081416 "Flush Wood Doors" for flush wood doors to receive glazing specified in this Section.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Compatibility: All glazing system materials shall be proven aesthetically and functionally compatible over the anticipated exposure conditions and design service life of the glazing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedule at the end of this Section, or comparable product by one of the following:

1. Guardian Industries Corp.
2. Viracon, Inc.
3. Vitro S.A.B. de C.V. (formerly PPG).

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Safety Glazing: Where safety glazing is required, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Glazing Manual."
2. IGMA Publication: "IGMA Technical Binder."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Reflective-Coated Vision Glass: ASTM C 1376.

2.5 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

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

a. Dow Corning Corporation; 995.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A Durometer hardness of 85, plus or minus 5.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications. Maintain consistency with applicable guidance published by the National Glass Association (NGA). and Maintain consistency with National Glass Association (NGA)/'Glass Association of North America (GANA)'s "GANA Glazing Manual: 50th Anniversary Edition"**.**

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Where temporary construction films are necessary to protect the glazing, the films shall be transparent and colorless in order to limit the potential for induced thermal stress breakage of the glass.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. GLASS TYPE GL-MA: Clear, annealed float glass.

1. Minimum Thickness: 6.0 mm.

B. GLASS TYPE GL-MC (T): Clear, fully tempered float glass.

1. Minimum thickness: 6.0 mm.
2. Provide safety glazing labeling.

C. Glass Type GL-R1: Reflective-coated vision glass (two-way mirror, one-way glass); fully tempered float glass.

1. Kind: Kind CV (coated vision glass).
2. Coating Type: Pyrolytic.
3. Coating Color: Silver.
4. Glass: Clear float glass.
5. Minimum Thickness: 6 mm.

6. Coating Location: First surface.
7. Safety glazing required.

END OF SECTION

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.
4. Kneewall Connector.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking installed in non-structural metal framing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For embossed steel studs and runners, firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

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, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. .

2.2 FRAMING SYSTEMS

A. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

B. 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 , hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645. Use either steel studs and runners or embossed steel studs and runners.

1. Steel Studs and Runners:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich Building Systems.
3) MBA Building Supplies.
4) Phillips Manufacturing Co.
5) Steel Network, Inc. (The).
6) Telling Industries.

b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.

1) Provide not less than 20 ga. studs behind surfaces indicated to have tile or wall-hung cabinets.

c. Depth: As indicated on Drawings.

2. Embossed Steel Studs and Runners:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich Building Systems.
3) MarinoWARE.
4) MBA Building Supplies.
5) Phillips Manufacturing Co.
6) Steel Network, Inc. (The).
7) Telling Industries.

b. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements.

1) Provide not less than 20 ga. studs behind surfaces indicated to have tile or wall-hung cabinets.

c. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Firestop Deflection Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

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

a. Blazeframe Industries; Intumescent Framing, Fire Stop System.
b. CEMCO; California Expanded Metal Products Co.; FAS Track.
c. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.

F. Backing Track: Steel track for blocking and bracing cabinets and equipment.

1. Provide 0.0478 inch (18 gauge) x 6 inch wide backing track extended to nearest stud past cabinet or equipment on both sides. Secure backing to stud with (3) #10 SMS per stud, typical.

G. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0478 inch (18 gauge).

H. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches , 0.068-inch- thick, galvanized steel.

I. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0329 inch .
2. Depth: As indicated on Drawings.

J. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: As indicated on Drawings.

K. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.

2.3 KNEEWALL CONNECTOR

A. Description: Rigid connector to resist overturning moment at the base of interior partial-height walls.

B. Basis-of-Design: Simpson RCKW Kneewall Connector for Cold-Formed Steel Construction.

1. Material: RCKW and RCKWS, 171 mil (7 ga), 33 ksi.
2. Coating: Galvanized (G90).
3. Fasteners: Screw fasteners as required by Manufacturer.

2.4 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches .

D. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

3. Embossed Steel Studs and Runners: ASTM C 645.

4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

5. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

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

a. Armstrong World Industries, Inc; Drywall Grid Systems.
b. Chicago Metallic Corporation; .
c. United State Gypsum Company; Drywall Suspension System.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 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.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts 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 runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

B. 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. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Sound-attenuation blankets.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates that affect gypsum board scope.
2. Section 078413 "Penetration Firestopping" for rated firestopping in gypsum board walls.
3. Section 079219 "Acoustical Joint Sealants" for acoustical sealants in gypsum board walls.
4. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include product data indicating compliance with UL Assemblies indicated on Drawings.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. 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. Continental Building Products, LLC.
    d. Georgia-Pacific Building Products.
    e. National Gypsum Company.
    f. PABCO Gypsum.
    g. Temple-Inland Building Products by Georgia-Pacific.
    h. USG.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

B. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.
    b. Georgia-Pacific Building Products.
    c. National Gypsum Company.
    d. PABCO Gypsum.
    e. Temple-Inland Building Products by Georgia-Pacific.

f. USG.

2. Core: 5/8 inch, Type X.
3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
6. Long Edges: Tapered.

C. 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, provide products by one of the following:

a. American Gypsum.
b. Georgia-Pacific Building Products.
c. National Gypsum Company.
d. PABCO Gypsum.
e. Temple-Inland Building Products by Georgia-Pacific.
f. USG.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. Curved-Edge Cornerbead: With notched or flexible flanges.
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 beads.

1) Architectural intersections.

a) Where vertical and horizontal expansion (control) joints intersect, provide manufacturer's fabricated architectural intersection bead to match expansion (control) joint bead profile.

g. Shadow and reveal beads.

1) Architectural intersections.

a) Where vertical and horizontal expansion (control) joints intersect, provide manufacturer's fabricated architectural intersection bead to match shadow and reveal bead profile.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Fry Reglet Corporation.
b. Gordon, Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 , Alloy 6063-T5.
3. Finish: As indicated on Drawings.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

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 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 drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.6 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.

1. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Where required for fire-resistance-rated assembly. Type X is also permitted in lieu of Wallboard Type.
2. Abuse-Resistant Type: As indicated on Drawings.
3. Mold-Resistant Type: On non-tile surfaces in restrooms, and in locker rooms without showers.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers .

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Curved-Edge Cornerbead: Use at curved openings.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use where indicated.
6. Shadow and Reveal Beads: Use where indicated.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
5. Level 5: Where indicated on Drawings and behind the following:.

    a. Custom graphic wall coverings.

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Porcelain wall tile, patch and repair to match existing.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.

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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

2.2 PRODUCTS, GENERAL

A. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.3 TILE PRODUCTS

A. Ceramic Tile Type: Glazed porcelain wall tile to match existing size and color.

1. Face Size: Match existing.
2. Thickness: Match existing.
3. Tile Color, Glaze, and Pattern: Match existing.
4. Grout Color: Match existing.
5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard shapes.

2.4 SETTING MATERIALS

A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

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

a. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar.
b. Laticrete International, Inc.; Laticrete 253 Gold.
c. MAPEI Corporation; MAPEI Porcelain Tile Mortar.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

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

    a. Custom Building Products; Prism Color Consistent Grout.
    b. Laticrete International, Inc; Laticrete PERMACOLOR Select.
    c. MAPEI Corporation; MAPEI Ultracolor Plus.

2.6 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. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

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

    a. Custom Building Products; Aqua Mix Concentrated Stone & Tile Cleaner.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.

b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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 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.

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.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Match existing.

H. Perimeter Movement Joints: Provide perimeter movement joints as described in TCNA EJ171 including as follows:

1. Where tilework abuts restraining surfaces such as perimeter walls, dissimilar floor finishes, curbs, columns, pipes, ceilings and where changes occur in backing materials, but not at drain strainers.
2. Inside corners in interior and exterior tilework.
3. Outside corners at exterior tilework only.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. 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. Sealer: Apply sealer to cementitious grout joints in tile according to sealer manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

a. Ceramic Tile Type: Ceramic wall tile.
b. Grout: High-performance grout.
c. Locations: Typical tile walls except as specified otherwise.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Acoustical panels and exposed suspension systems for interior ceilings.
2. Metal edge moldings and trim.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 3 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 3 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Low-Emitting Ceiling Materials: Provide materials/products, installed within the weatherproofing system, that comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

D. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.3 ACOUSTICAL PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in this Section or comparable product by one of the following:

1. Armstrong World Industries, Inc.

2. CertainTeed Corporation.
3. Chicago Metallic Corporation.
4. Rockfon, part of the Rockwool Group.
5. United States Gypsum Company.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

D. Acoustical Panel:

1. Basis-of-Design: Armstrong School Zone Fine Fissured, #1810.
2. Classification:

a. Type and Form: Type III, mineral base with painted finish, Form 2, water felted.
b. Pattern: CE (perforated small holes and lightly textured).

3. Color: White.
4. Light Reflectance (LR): Not less than 0.85.
5. Ceiling Attenuation Class (CAC): Not less than 40.
6. Noise Reduction Coefficient (NRC): Not less than 0.70.
7. Articulation Class (AC): n/a.
8. Edge/Joint Detail: Square, Lay-in.
9. Thickness: 15/16 inch.
10. Modular Size: 24 inch x 24 inch.
11. Grid: Prelude XL 15/16 inch, color: White.

E. Acoustical Panel:

1. Basis-of-Design: Armstrong School Zone Fine Fissured, #1714.
2. Classification:

a. Type and Form: Type III, mineral base with painted finish, Form 2, water felted.
b. Pattern: CE (perforated small holes and lightly textured).

3. Color: White.
4. Light Reflectance (LR): Not less than 0.85.
5. Ceiling Attenuation Class (CAC): Not less than 40 .
6. Noise Reduction Coefficient (NRC): Not less than 0.70.
7. Articulation Class (AC): n/a.
8. Edge/Joint Detail: Square, Lay-in.
9. Thickness: 15/16 inch.
10. Modular Size: 24 inch x 48 inch.
11. Grid: Prelude XL 15/16 inch, color: White.

2.4 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in this Section or comparable product by one of the following:

1. Armstrong World Industries, Inc.

2. CertainTeed Corporation.
3. Chicago Metallic Corporation.
4. United States Gypsum Company.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
3. Cap Material: Cold-rolled steel.
4. Cap Finish: Painted.

2.5 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. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

2.6 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

1. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

B. Related Requirements:

1. See Section 012300 "Alternates" for alternates related to resilient base and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 3 percent, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

B. Transport resilient moldings in a manner to minimize stretching. Do not carry over-the-shoulder.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

2.2 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products indicated on drawings, or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. Johnsonite; A Tarkett Company.
3. Mannington Commercial.
4. Mondo Rubber International, Inc.
5. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style B, Cove: Provide where indicated on Drawings.

C. Thickness: 0.125 inch.

D. Height: As indicated on Drawings.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: As indicated on Drawings.

2.3 RUBBER STAIR ACCESSORIES

A. Low-Emitting Flooring:Provide hard surface flooring that meets testing and product requirements of FloorScore.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. Johnsonite; A Tarkett Company.
3. Mondo Rubber International, Inc.
4. Roppe Corporation, USA.

C. Stair Treads: ASTM F 2169.

1. Type: TP (rubber, thermoplastic).
2. Class: 1 (smooth, flat).
3. Group: 2 (with contrasting color for the visually impaired).
4. Nosing Style: .
5. Nosing Height: .
6. Thickness: 1/4 inch and tapered to back edge.
7. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
8. Integral Risers: Smooth, flat; in height that fully covers substrate.

D. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

E. Locations: Provide rubber stair accessories in areas indicated on Drawings.

F. Colors and Patterns: As indicated on Drawings.

2.4 RUBBER MOLDING ACCESSORY

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. Johnsonite; A Tarkett Company.
2. Roppe Corporation, USA.
3. VPI, LLC, Floor Products Division.

B. Description: Rubber transition strips.

C. Profile and Dimensions: As indicated on Drawings.

D. Locations: Provide rubber molding accessories in areas indicated on Drawings.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.5 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.

1. Adhesives shall have a VOC content of 50 g/L or less and 60 g/L or less for rubber stair treads.

2. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 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.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

1. Begin installation of resilient moldings only after the work of all other trades have been completed.
2. Do not stretch transitional moldings during delivery or installation, to avoid gaps that will need to be reworked under warranty.

    a. Maximum allowable gap after 6 months is 1/16 inch.

3. Areas to receive resilient moldings shall be clean, fully enclosed, weathertight, and maintained at uniform temperature of at least 65 degrees for 24 hours before, during, and after the installation is competed. Condition transitional moldings and adhesives in the same manner.
4. Provide a floor surface that is smooth, flat, level, permanently dry, clean, and free of all foreign material such as dust, paint, grease, oils, solvents, curing and hardening compounds, sealers, asphalt, and old adhesive residue.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes vinyl sheet flooring.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: For each exposed product and for each color and texture specified in manufacturer's standard size, but not less than 6-by-9-inch sections.

D. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Sheet Flooring: Furnish not less than 3 percent in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

B. Low-Emitting Flooring: Provide hard surface flooring that meets testing and product requirements of FloorScore.

2.2 UNBACKED VINYL SHEET FLOORING

A. Product Standard: ASTM F 1913.

B. Seamless-Installation Method: Chemically bonded.

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 resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

1. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

C. Seamless-Installation Accessories:

1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
2. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
2. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

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 adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring 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.

I. Integral-Flash-Cove Base: Cove resilient sheet flooring in locations and height indicated on Drawings up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Luxury vinyl tile (LVT)

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for rubber floor transitions.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include adhesive and RH level of performance.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Testing Results: For alkalinity and adhesion testing, and moisture testing, including anhydrous calcium chloride test and relative humidity test.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 3 percent, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

C. Low-Emitting Flooring: Provide hard surface flooring that meets the requirements of the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario, and also meets testing and product requirements of FloorScore.

2.2 LUXURY VINYL FLOOR TILE

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or approved substitution.

B. Tile Standard: ASTM F 1700.

1. Class: As indicated by product designations.
2. Type: A, smooth surface.

C. Thickness: As indicated on Drawings.

D. Size: As indicated on Drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.
2. Provide adhesive for use over high-moisture concrete slabs up to 95% RH.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170.

        1) Where warranted by flooring manufacturer, installation over higher RH levels is permitted.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated on Drawings.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated on Drawings.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

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SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Modular carpet tile.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates related to carpet tiling.
2. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

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. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.

7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Moisture Testing Reports: Include PH, Calcium-Chloride, and relative humidity (RH).

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 3 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.10 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or approved substitution by one of the following:

1. Collins and Aikman Floor Coverings.
2. Interface, LLC.
3. Mannington Mills, Inc.
4. Milliken & Company.
5. Mohawk Group (The); Mohawk Carpet, LLC.
6. Shaw Contract Group; a Berkshire Hathaway company.
7. Tandus; a Tarkett company.

B. Pattern: As indicated on Drawings.

C. Fiber Content: 100 percent nylon 6, 6.

D. Fiber Type: Antron Lumina, Antron Legacy, Universal.

E. Primary Backing/Backcoating: Manufacturer's standard composite materials .

F. Secondary Backing: Manufacturer's standard material for moisture barrier.

G. Size: As indicated on Drawings.

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. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Alkalinity and Adhesion Testing: Perform tests recommended by carpeting manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
2. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

        1) Where warranted by flooring manufacturer, installation over higher RH levels is permitted.

    c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

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.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Custom graphic vinyl wall covering.

B. Related Requirements:

1. Section 012300 "Alternates" for wall covering alternates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- long in size.

1. For custom graphic wall coverings, verify the proposed sample print area with architect prior to sample submittal.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Provide materials/products that have post- and/or pre-consumer recycled content, by weight of total product.

B. Low-Emitting Wall Coverings: Provide materials/products, installed within the weatherproofing system, that comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

C. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2.2 CUSTOM GRAPHIC VINYL WALL COVERING

A. Description: durable, washable, floor-to-ceiling and wall-to-wall custom graphic vinyl wallcovering.

1. Basis-of-Design: Subject to compliance with requirements, provide product indicated on Drawings, or approved substitution.
2. Roll Width: Not less than 52 inches.
3. Thickness: Manufacturer's standard thickness.
4. Finish: Matte.
5. Fire Resistance: ASTM E-84, Class B, NFPA 253 (Critical Radiant Flux).
6. Bacterial Resistance: Yes.
7. Custom graphic: Match digital image provided by Architect.

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

1. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

1. Low-Emitting Paints and Coatings: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.2 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Install wall covering without lifted or curling edges and without visible shrinkage.

C. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

D. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

E. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

F. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

G. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

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SECTION 098453.01 - SOUND BARRIER MULLION TRIM CAP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes sound barrier mullion trim caps providing sound transmission control at adjacent storefront.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for joint sealing.
2. Section 092216 "Non-Structural Metal Framing" for adjacent stud framing.
3. Section 092116 "Gypsum Board Assemblies" for adjacent wall board.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sound barrier wall end cap system.

B. Shop Drawings:

1. Include typical dimensioned cross-section(s) at the location where drywall partition terminates at the perimeter curtain wall, indicating:

a. Dimensions
b. Finish

C. Samples: For each exposed product and for each color and texture specified.

1. Size: 6 inch sound barrier mullion trim cap sample and minimum 2 inch x 3 inch custom color paint sample.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each sound barrier mullion trim cap assembly, for ASTM E 90 tests performed by a qualified third party testing agency.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of aluminum extrusions and anodizing shall be ISO-9001 certified.

B. Installer Qualifications: An entity that employs installers and supervisors who are approved by manufacturer.

C. Testing Agency Qualifications: ASTM E 90 testing to be performed by laboratory accredited by IAS as complying with ISO/IEC Standard 17025.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver sound barrier mullion trim caps until spaces to receive them are clean, dry, and ready for their installation.

B. Store sound barrier mullion trim caps in original undamaged packaging inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Division 01 Section "Product Requirements."

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace sound barrier mullion trim caps that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years limited warranty from date of Substantial Completion.
2. Limited warranty does not cover adjacent products or improper installation.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide sound barrier mullion trim caps of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in lengths of sufficient additional length to allow for field trimming to required length to match variations in construction tolerances of adjacent systems.

2.2 PERFORMANCE REQUIREMENTS

A. Sound Transmission:

1. Double-Sided Installations: STC 55 or higher.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Mullion trim cap to be sized to accommodate thermal movement.

2.3 SOUND BARRIER MULLION TRIM CAP

A. Basis-of-Design: Subject to compliance with requirements, provide Mull-It-Over 55 Mullion Trim Cap, or approved substitution by one of the following:

1. Gordon Incorporated; Mullion Mate Adjustable Partition Closure.
2. Mull-It-Over Products; Mullion Trim Cap.

B. Profile: As indicated on Drawings.

2.4 COMPONENTS

A. Aluminum Extrusions:

1. Thickness: Manufacturer's standard, but not less than 0.125 inches.
2. Profile: As selected and approved by Architect to allow solid attachment and fastening to the partition wall framing.

B. Sound Absorbing Foam:

1. Resistant to smoke, flame, and microbial growth.
2. Fire Rating: ASTM E 84 Class 1.
3. Fungi Resistance: Zero rating per ASTM G 21.

C. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.

1. Thickness: Standard 1/2 inch, or 1 inch to accommodate a larger mullion deflection.
2. Color: Manufacturer's standard.

D. Fasteners:

1. Self Tapping or appropriate threaded fastener.
2. Compatible with all materials fasteners will contact with and not causing galvanic corrosion.

E. Snap Cover: Snap-on fastener cover.

F. Acoustical Sound Sealant: Acrylic latex based.

2.5 ACCESSORIES

A. Provide necessary and related parts and tools to complete installation.

2.6 FABRICATION

A. Extrusions and generic profiles to be shipped in custom lengths as required to meet project requirements or shipped in standard incremental foot lengths and cut to exact length on jobsite.

2.7 FINISHES

A. Finish:

1. Clear Anodized Finish; A-M10 C22 A41 Class I (0.7 to 1.0 thick anodic coating).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls and adjacent curtain wall for suitable conditions where sound barrier wall end cap will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Measure and cut sound barrier wall end cap to proper lengths.

B. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.

C. Apply continuous bead of acoustical sealant to the unexposed side of extruded aluminum surface that will be in contact with the drywall edge.

D. Place sound barrier wall end cap on the vertical surface of the drywall partition wall and loosely install fasteners in the top and bottom slotted holes of the wall end cap.

E. Plumb the wall end cap leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.

F. Tighten top and bottom fasteners to secure end cap.

G. Install additional fasteners at 12 inches on center, minimum.

H. Install snap cover to conceal fasteners.

I. Apply color matched sealant at joints of dissimilar materials as desired.

3.3 CLEANING

A. After work is complete in adjacent areas, clean exposed surfaces with suitable cleaner that will not harm or attack the finish.

3.4 PROTECTION

A. Protect sound barrier wall end caps from damage during installation, general construction activities, and until turnover of structure.

END OF SECTION 098453.01

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMUs).
3. Steel and iron.
4. Galvanized metal.
5. Gypsum board.
6. Code-required marking and identification of walls.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates related to interior painting.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.3 DEFINITIONS

A. Coat of Paint: An application of paint, applied not less than the manufacturer's recommended duration for recoat based on relative humidity and ambient temperature.

B. MPI Gloss Level 1 (Flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 2 (Low Sheen): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

F. MPI Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.

H. MPI Gloss Level 7 (High-Gloss): More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: Not less than 2 gal. of each material and color applied.

1.6 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..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide basis-of-design products indicated in this Section, or approved substitutions by one of the following :

1. Benjamin Moore & Co.
2. PPG Paints.
3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

B. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the 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. Colors: As indicated on Drawings.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. 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.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2.
2. SSPC-SP 3.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Apply coats of paint per manufacturer's recommendations based on relative humidity and ambient temperature, but not less than 24-48 hours between coats for temperatures below 45 degrees F, and not less than 4 hours between coats applied above 45 degrees F.
2. Use applicators and techniques suited for paint and substrate indicated.
3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. 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.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

   a. Tanks that do not have factory-applied final finishes.
   b. Natural gas lines, if any.

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

B. All Surfaces, preparation, and paint applications may be inspected.

C. Painted exterior and interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the Painting Inspection Agency inspector:

1. Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and reentrant angles.
3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

D. Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:

1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

E. Painted surfaces rejected by the inspector shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

1. Extend paint to from wall corner-to-corner, or corner-to-control-joint, or control-joint-to control-joint, when touch-up extents are otherwise visible.

3.6 CODE-REQUIRED MARKING AND IDENTIFICATION OF WALLS, BARRIERS, AND PARTITIONS WITH PROTECTED OPENINGS AND PENETRATIONS

A. Stencil all fire walls, fire barriers, smoke barriers, non-rated smoke partitions, and any other wall required to have protected openings or penetrations with lettering not less than 3-inches in height with minimum 3/8" stroke in a contrasting color, in accessible concealed floor, floor-ceiling, or attic spaces. Identify the names and hour rating of the partition, wall, or barrier approximately 8-inches above the ceiling within 15 feed of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition on both sides and at least one in every space. Labels may include, but are not limited to, the following:

1. SMOKE PARTITION
2. 1-HR FIRE PARTITION
3. 1-HR FIRE BARRIER
4. 1-HR SMOKE BARRIER
5. 1-HR FIRE WALL

6. 2-HR FIRE WALL

3.7 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.

1) Benjamin Moore: Ultra Spec Interior/Exterior Acrylic High-Build Masonry Primer, 5.3 mils wet, .95 mils dry.
2) PPG Paints: Speedhide Zero Interior Latex Sealer, 6-4900XI Series; applied at 1.4 mils dft.
3) Sherwin-Williams: Loxon Concrete & Masonry Primer Sealer, LX02W50, at 8.0 mils wet, 3.2 mils dry.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore: Ultra Spec 500 Semi-Gloss (539), 4.3 mils wet, 1.8 mils dry.
2) PPG Paints: Speedhide Zero Interior Latex Semi-Gloss, 6-4510XI Series; applied at 1.4 mils dft per coat.
3) Sherwin-Williams: ProMar 200 Zero VOC Latex semi-gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. Location: Exposed interior concrete walls and ceilings.

B. Concrete Substrates, Traffic Surfaces:

1. Water-Based Concrete Floor Sealer System:

a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, water based, for concrete floors.

1) Benjamin Moore: Corotech Clear Acrylic Sealer Low Lustre (V027).
2) PPG Paints: Perma-Crete Plex-Seal WB Interior/Exterior 100% Acrylic Clear Sealer, 4-6200XI Series; applied at 0.8 mils dft per coat.
3) Sherwin-Williams: H&C Clarishield Water-Based Wet-Look Concrete Sealer, at 100 to 200 sq. ft. per gal.

c. Location: Exposed horizontal concrete surfaces.

C. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Block Filler: Block filler, latex, interior/exterior.

1) Benjamin Moore: Coronado Super Kote 5000 Latex Production Block Filler 958.

2) PPG Paints: Speedhide Interior/Exterior Masonry Hi Fill Latex Block Filler, 6-15XI; applied at 8 mils dft.
3) Sherwin-Williams: PrepRite Block Filler, B25W25, at 100 to 200 sq .ft. per gal.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore: Ultra Spec Interior Gloss Finish N540/K540.
2) PPG Paints: Speedhide Zero Interior Latex Semi-Gloss, 6-4510XI Series; applied at 1.3 mils dft per coat.
3) Sherwin-Williams: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. Location: Interior CMU walls except as noted otherwise.

D. Steel Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore: Ultra Spec Scuff-X Acrylic Latex, Semi-Gloss (487).
2) PPG Paints: Pitt-Glaze WB-1, Pre-Catalyzed Acrylic Semi-Gloss Epoxy, 16-510 Series; applied at 1.5 mils dft per coat.
3) Sherwin-Williams: Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

d. Location: Hollow metal doors and frames, wall grilles, other steel/iron except as noted.

2. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, rust-inhibitive, water based.

1) Benjamin Moore: Coronado Rust Scat Waterborne Metal Primer 36.
2) PPG Paints: Pitt-Tech Interior/Exterior Industrial DTM Primer, 90-712 Series, applied at 2 mils dft.
3) Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore: Corotech Pre-Catalyzed Epoxy Eggshell V342.
2) PPG Paints: Pitt-Glaze WB1, Pre-Catalyzed Acrylic Semi-Gloss Epoxy, 16-510 Series; applied at 1.5 mils dft per coat.
3) Sherwin-Williams: Pro Industrial Pre-Catalyzed Water-Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

d. Location: Interior steel stairs and fabricated steel handrails, other steel intended for human touch.

E. Galvanized-Metal Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, galvanized, water based.

1) Benjamin Moore: Ultra Spec HP Acrylic Metal Primer (HP04).
2) PPG Paints: Pitt-Tech Plus Interior/Exterior Industrial DTM Primer/Finish, 4020 PF Series; applied at 2.2 mils dft.
3) Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer, B66-2310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore: Ultra Spec Interior Gloss Finish N540/K540.
2) PPG Paints: Pitt-Glaze WB1, Pre-Catalyzed Acrylic Semi-Gloss Epoxy, 16-510 Series; applied at 1.5 mils dft per coat.
3) Sherwin-Williams: Pro Industrial Acrylic Semi-Gloss,m B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

d. Location: Galvanized steel within typical reach range or intended for human touch.

F. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.

1) Benjamin Moore: Ultra Spec 500 Waterborne Interior Primer N534/K534.
2) PPG Paints: Speedhide Zero Interior Latex Sealer, 6-4900XI Series; applied at 1.4 mils dft.
3) Sherwin-Williams: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore: Ultra Spec Interior Gloss Finish N540/K540.
2) PPG Paints: Speedhide Zero Interior Latex Semi-Gloss, 6-4510XI Series; applied at 1.4 mils dft per coat.
3) Sherwin-Williams: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. Locations: Typical gypsum board paint, except as otherwise noted.

2. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer sealer, latex, interior.

   1) Benjamin Moore: Ultra Spec 500 Waterborne Interior Primer Sealer N534/K534.
   2) PPG Paints: Speedhide Zero Interior Latex Sealer, 6-4900XI; applied at 1.4 mils dft.
   3) Sherwin-Williams: ProMar 200 Zero VOC Latex Primer, B28-2600, at 4.0 mils wet, 1.0 mils dry.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).

   1) Benjamin Moore: Corotech Pre-Catalyzed Epoxy Semi-Gloss V341.
   2) PPG Paints: Pitt-Glaze WB1 Pre-Catalyzed Acrylic Semi-Gloss Epoxy, 16-510 Series; applied at 1.5 mils dft per coat.
   3) Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-1151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

d. Location: Gypsum board paint in toilet rooms, locker rooms, laboratories, hallways.

END OF SECTION 099123

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SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Visual display board assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
2. Include electrical characteristics for motorized units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints.
3. Include sections of typical trim members.
4. Include wiring diagrams for power and control wiring.

C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:

1. Samples of facings for each visual display panel type, indicating color and texture.

D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces exhibit crazing, cracking, or flaking.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

A. Basis-of-Design Product: Subject to compliance with requirements, provide Claridge Products, Series 3, or comparable product by one of the following:

1. Claridge Products and Equipment, Inc.
2. Clarus Glassboards LLC.
3. Egan Visual Inc.
4. Marsh Industries, Inc.; Visual Products Group.
5. Peter Pepper Products, Inc.

B. Visual Display Board Assembly: factory fabricated.

1. Assembly: Markerboard .
2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting Method: Mechanically fastened with concealed fasteners.

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.

1. Color: As selected by Architect from full range of industry colors.

D. Aluminum Frames: Fabricated from not less than 0.062-inch- thick, extruded aluminum; standard size and shape.

1. Aluminum Finish: Clear anodic finish.

E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

F. Chalktray/Markertray: Manufacturer's standard; continuous.

1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.3 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch(25 gauge) uncoated base metal thickness.
2. Particleboard Core: 7/16 inch thick; with 0.015-inch- thick, aluminum sheet backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.4 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

1. Provide magnetic porcelain-enamel where indicated.

B. Hardboard: ANSI A135.4, tempered.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Prime wall surfaces indicated to receive visual display units and and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.

3.4 CLEANING AND PROTECTION

A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

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SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cutout dimensional characters.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates related to dimensional letter signage.

1.3 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 Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Full-size Sample of each type of dimensional character.
2. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ACE Sign Systems, Inc.
2. ASI Sign Systems, Inc.
3. Avalis Wayfinding Solutions, Inc.
4. Colorado Sign Systems (CSS).
5. Gemini Incorporated.
6. GraphicWorks, LLC.
7. Metal Arts; Division of L & H Mfg. Co.

2.2 DIMENSIONAL CHARACTERS

A. Cutout Characters : Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:

1. Character Material: Sheet or plate aluminum.
2. Character Height: As indicated on Drawings.
3. Thickness: 0.25 inch.
4. Finishes:

    a. Integral Aluminum Finish: Clear anodized.

5. Mounting: Adhesive.
6. Typeface: As indicated on Drawings.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.4 ACCESSORIES

A. Adhesive: As recommended by sign manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the 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."

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. 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. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Room-identification signs.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
2. Divisions 22, 23, and 26 for labels, tags, and nameplates for plumbing, HVAC, and electrical systems and equipment.
3. Section 265100 "Interior Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Provide and install paper mockups for review prior to fabrication. Provide full-scale black/white sheets displaying the proposed graphics. Fasten to substrate with removable tape.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

A. Manufacturers: Suabject to compliance with requirements, provide products by one of the following:

1. ASI Sign Systems, Inc.
2. Avalanche Sign Contracting.
3. Avalis Wayfinding Solutions, Inc.
4. Best Sign Systems Inc.
5. Colorado Sign Systems (CSS).
6. FastSigns of DTC, CO.
7. GraphicWorks, LLC.
8. Innerface Architectural Signage, Inc.
9. Shapiro Graphics, LLC.
10. Signworks, LLC.
11. Takeform.

B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign: Acrylic face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: 0.25 inch.
b. Face Sheet:

1) Thickness: 0.125 inch.
2) Finish: Clear matte acrylic with painted subsurface .

a) Subsurface (Second-Surface) Color: To be selected from manufacturer's full range.

c. Backing Sheet:

1) Thickness: 0.080 inch.
2) Color: To be selected from manufacturer's full range.

d. Surface-Applied Graphics: Applied vinyl graphics bonded to the face sheet.

1) Thickness: 1/32 inch.
2) Color: To be selected from manufacturer's full range.

2. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: Square cut.
b. Corner Condition in Elevation: Rounded to radius indicated.

3. Mounting: Surface mounted to wall with two-face tape.
4. Text and Typeface: Accessible raised characters and Braille typeface matching Architect's sample. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

1. Basis-of-Design: Provide 3M "VHB Heavy Duty Mounting Tape" or comparable product.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. 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 connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets 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.

B. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated on Drawings, and according to accessibility standard.

C. Mounting Methods:

1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

D. Signs Mounted on Glass: Install self-adhering vinyl to the face-of-glass and fasten the sign over the vinyl. Provide vinyl size to match the sign size, and color to match the sign backing color.

1. Vinyl Thickness: 1/32 inch.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 102123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Curtain tracks and carriers.
2. Cubicle curtains.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for supplementary wood framing and blocking for mounting items requiring anchorage.
2. Section 092216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include durability, laundry temperature limits, fade resistance, applied curtain treatment, and fire-test-response characteristics for each type of curtain fabric indicated.
2. Include data for each type of track.

B. Shop Drawings:

1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
2. Include details on blocking .

C. Samples: For each exposed product and for each color and texture specified, 10 inches in size.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Curtains: Provide curtain fabrics with the following characteristics:

1. Launderable to a temperature of not less than 160 deg F.
2. Flame resistant and identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CURTAIN SUPPORT SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Inpro Optitrac Cubicle Curtain Track CE5000, contact InPro/Becky Parnell, 720-256-3395 or comparable product by one of the following:

1. Covoc Corporation.
2. C/S General Cubicle.
3. InPro Corporation.
4. A. R. Nelson Co.
5. Salsbury Industries.

B. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high; with 0.058-inchminimum wall thickness.

1. Curved Track: Factory-fabricated, 12-inch- radius bends.
2. Finish: Baked enamel, acrylic, or epoxy.

C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

1. End Stop: Removable with carrier hook.

D. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.

E. Exposed Fasteners: Stainless steel.

F. Concealed Fasteners: Hot-dip galvanized.

2.3 CURTAINS

A. Basis-of-Design Product: Subject to compliance with requirements, provide InPro products, contact InPro/Becky Parnell, 720-256-3395 or comparable product by one of the following:

1. Covoc Corporation.
2. C/S General Cubicle.
3. A. R. Nelson Co.

4. Salsbury Industries.

B. Cubicle Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.

1. Pattern: As selected by Architect from manufacturer's full range.
2. Color: As selected by Architect from manufacturer's full range.

C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

D. Mesh Top: Not less than 22-inch- high mesh top of No. 50 nylon mesh.

E. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.4 CURTAIN FABRICATION

A. Fabricate curtains as follows:

1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches added fullness.
2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor as follows:

a. Cubicle Curtains: 12 inches.

3. Top Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched.
4. Mesh Top: Top hem of mesh not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 1/2-inch triple thickness, top hem of curtain fabric.
5. Bottom Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced, and double lockstitched.
6. Side Hems: Not less than 1/2 inch and not more than 1-1/4 inches wide, with triple turned edges, and single lockstitched.

B. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install tracks level and plumb, according to manufacturer's written instructions.

B. Up to 20 feet in length, provide track fabricated from single, continuous length.

1. Curtain Track Mounting: Surface.

C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:

1. Mechanically fasten directly to finished ceiling with toggle bolts.
2. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
3. Mechanically fasten to suspended ceiling grid with screws.
4. Attach track to suspended ceiling grid with manufacturer's proprietary clip.

D. Suspended-Track Mounting: Install track with manufacturer's standard tubular aluminum suspended supports at intervals and with fasteners recommended by manufacturer. Fasten supports to structure. Provide supports at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.

E. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

F. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

G. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

END OF SECTION

SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually operated, acoustical panel partitions.

B. Related Requirements:

1. Section 012300 "Alternates" for alternates related to folding panel partitions.
2. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
3. Section 092900 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.

1.3 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Include attendance by manufacturer's representative.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For operable panel partitions.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
3. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

1. Textile Facing Material: Full width by not less than 36-inch- long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
3. Panel Edge Material: Not less than 3 inches long.
4. Chair Rail: Manufacturer's standard-size unit, 6 inches long.
5. Glass: Units 12 inches square.
6. Hardware: One of each exposed door-operating device.

1.6 INFORMATIONAL SUBMITTALS

A. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

B. Qualification Data: For qualified Installer.

C. Product Certificates: For each type of operable panel partition.

1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

D. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
b. Seals, hardware, track, track switches, carriers, and other operating components.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of operable panel partitions.
b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period:

a. Panels: Two years from date of Substantial Completion.
b. Steel Tracks: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.

B. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

C. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

D. Low-Emitting Paints and Coatings: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1113 OR California Air Resource Board (CARB) 2007-Suggested Control Measures (SCM) for Architectural Coatings, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

E. Low-Emitting Composite Wood: Provide materials/products that have low formaldehyde emissions that meet the California Air Resources Board (CARB) ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

F. Low-Emitting Wall Coverings: Provide materials/products, installed within the weatherproofing system, that comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

2.2 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Modernfold Encore, or comparable product by one of the following:

a. Hufcor Inc.
b. Modernfold, Inc.

B. Panel Operation: Manually operated, paired panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: As indicated.

E. STC: Not less than 54.

F. Panel Weight: 11 lb/sq. ft. maximum.

G. Panel Thickness: Not less than 4 inches.

H. Panel Materials:

1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.

1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal Flexible, resilient PVC, bulb-shaped acoustical seal.

J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

1. Hinges: Manufacturer's standard.

2.3 SEALS

A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:

1. Manufacturer's standard seals unless otherwise indicated.
2. Seals made from materials and in profiles that minimize sound leakage.
3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.

D. Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

2.4 PANEL FINISH FACINGS

A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.

B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.

1. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
2. Color/Pattern: As selected by Architect from manufacturer's full range.

C. Work Surfaces: Markerboard/Projection and Tackable Surfaces.

1. See Article "ACCESSORIES" for work surface details.

D. Paint: Manufacturer's standard painted finish.

1. Color: As selected by Architect from manufacturer's full range.

E. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.5 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

D. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

1. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.

B. Work Surfaces: Quantities, placement, and size indicated.

1. Surface: Standard steel marker/projection surface (whiteboard finish).

2. Surface Color: As selected by Architect from manufacturer's full range.
3. Size: Full width of panel by 48 inches.
4. Trim: Aluminum slip-on or snap-on trim with no visible screws or exposed joints and with corners mitered to a neat, hairline joint.

C. Recessed Marker/Eraser Storage Pockets: Finished to match Trim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 FIELD QUALITY CONTROL

A. An operable panel partition installation will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Verify that safety devices are properly functioning.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall guards.
2. Corner guards, stainless steel.

B. Related Requirements:

1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1. Include Samples of accent strips and accessories to verify color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 96-inch- long units.
2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

    a. Store corner-guard covers in a vertical position.
    b. Store wall-guard covers in a horizontal position.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 WALL GUARDS

A. Bumper Rail WP-2 : Standard-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:

    a. Construction Specialties, Inc.
    b. InPro Corporation (IPC).
    c. Korogard Wall Protection Systems; a division of RJF International Corporation.

2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; in dimensions and profiles indicated on Drawings.

3. Continuous Retainer: Minimum 0.080-inch- thick, one-piece, extruded aluminum.
4. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
5. Accessories: Concealed splices and mounting hardware.
6. Mounting: Surface mounted directly to wall.

2.4 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards CG-1: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide InPro Stainless Steel Corner Guard; contact InPro/Becky Parnell, 720-256-3395 , or comparable product by one of the following:

a. Construction Specialties, Inc.
b. InPro Corporation (IPC).
c. Korogard Wall Protection Systems; a division of RJF International Corporation.

2. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum .
b. Finish: Directional satin, No. 4.

3. Wing Size: As indicated on Drawings.
4. Corner Radius: 1/8 inch.
5. Mounting: Adhesive.

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: As recommended by protection product manufacturer.

2.6 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, 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.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust end caps as required to ensure tight seams.

D. Fire Doors: Install protection according to the listing of each item.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Activar Construction Products Group, Inc. - JL Industries.
b. Guardian Fire Equipment, Inc.
c. Larsens Manufacturing Company.
d. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated, and fire rated where required to match Wall Type.

C. Cabinet Material: Cold-rolled steel sheet.

D. Recessed Cabinet:

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Basis-of-Design: Larsen's FS 2409-6R.
2. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Steel sheetAluminum sheetStainless steel sheetCopper-alloy brass sheetCopper-alloy bronze sheetSame material and finish as door.

H. Door Material: Steel sheet.

I. Door Style: Fully glazed panel with frame.

J. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color:

a. Clear transparent acrylic sheet.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Decals.
3) Lettering Color: Red.
4) Orientation: Vertical.

M. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

a. Color: .

3. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

a. Finish: ASTM A480/A480M No. 4 directional satin finish,.

4. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.

3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessedsemirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessedsemirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply decals at locations indicated.
2. Apply decals on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers, and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Commercial-grade, of type, size, and capacity for each fire-protection cabinet , and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Guardian Fire Equipment, Inc.
b. JL Industries, Inc.; a division of the Activar Construction Products Group.
c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
d. Larsens Manufacturing Company.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Stainless steel.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

1. Locations: Provide in all locations, except where other types are specified in this Section.

2.3 MOUNTING BRACKETS

A. Mounting Brackets, FEC-0: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

1. Location: Where indicated on Drawings.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

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SECTION 105123 - PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes plastic-laminate-clad wood lockers .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.

B. Shop Drawings: For plastic-laminate-clad wood lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in lockers.
5. Show locker fillers, trim, base, sloping tops, and accessories.
6. Show locker identification system and numbering sequence.

C. Samples for Initial Selection: For each type of the following:

1. High-pressure decorative laminates.
2. Thermoset decorative overlay panels.
3. Carpet.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 PLASTIC-LAMINATE-CLAD WOOD LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Classic Woodworking, LLC.
2. Club Resource Group.
3. Famous Lockers, Inc.
4. Hollman, Inc.

5. Ideal Products, Inc.
6. Legacy Lockers.
7. List Industries Inc.
8. Treeforms.

B. Construction Style: Reveal overlay.

1. Reveal Dimension: 1/2 inch.

C. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Side Panels: 3/4 inch thick.
2. Back Panel: 3/8 inch thick.
3. Top Panel: 3/4 inch thick.
4. Bottom Panel: 3/4 inch thick.
5. Exposed Panel Edges: 3-mm-thick PVC.

D. Plastic-Laminate-Clad Wood Doors: High-pressure decorative laminate, Grade VGS, over both sides of particleboard core.

1. Thickness: Manufacturer's standard 3/4 or 5/8 inch thick.
2. Panel Edges: 3-mm-thick PVC.

E. End Panels: Match style, material, construction, and finish of plastic-laminate-clad wood doors.

F. Shelves: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay; fixed.

1. Thickness: 5/8 inch.
2. Exposed Edges: 3-mm-thick PVC.

G. Drawer Faces: Match style, material, construction, and finish of plastic-laminate-clad wood doors. Attach drawer faces to subfronts with mounting screws from drawer interior.

H. Drawer Subfronts, Sides, and Backs: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Thickness: 3/8 inch.
2. Exposed Edges: 3-mm-thick PVC.

I. Drawer Bottoms: 1/4-inch- thick, thermoset decorative overlay over particleboard core.

J. Corners and Filler Panels: 3/4-inch- thick panels. Match style, material, construction, and finish of plastic-laminate-clad wood doors.

K. Continuous Finish Base: Plastic-laminate-clad, 3/4-inch- thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

L. Continuously Sloping Tops: Plastic-laminate-clad, 3/4-inch- thick panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

1. Closures: -end type.

2. Sloping-top corner fillers, mitered.

M. Plastic-Laminate Colors, Patterns, and Finishes:

1. As indicated by manufacturer's designations.
2. Match Architect's samples.
3. As selected by Architect from plastic-laminate manufacturer's full range of solid colors.

2.3 MATERIALS

A. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, .

B. High-Pressure Decorative Laminate: NEMA LD 3, grades as follows:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade VGS.

C. Furring, Blocking, Shims, and Hanging Strips: Softwood lumber, kiln dried to less than 15 percent moisture content.

D. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

E. Wood Support Base: lumber treated with manufacturer's standard preservative-treatment, process.

2.4 HARDWARE

A. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.

1. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges; back mounted.

1. Provide two hinges for doors 36 inches high and less.
2. Provide three hinges for doors more than 36 inches high.

C. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

D. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, and rated for a load of 75 lbf.

E. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; finished to match other locker hardware. Attach hooks with at least two fasteners.

1. Provide two single-prong wall hooks for each compartment of single-tier and double-tier lockers.

F. Exposed Hardware Finish: Satin chrome unless otherwise indicated.

2.5 ACCESSORIES

A. Number Identification Plates: 1-1/2-inch- diameter, etched, embossed, or stamped, stainless-steel plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings. Finish plates to match other locker hardware.

2.6 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-wood members to 1/16-inch radius.

B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.
2. Join drawer subfronts, backs, and sides with manufacturer's standard glued joints.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

E. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

F. Attach PVC edging to panels by thermally fusing edging to panels after panel fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install wood support base with 1/2-inch- thick, plywood top.

B. Install lockers level, plumb, and true; use concealed shims.

C. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Locker Anchorage: Fasten lockers through wood locker base, at ends, and not more than 36 inches o.c. with No. 8 flush-head wood screws sized for 1-inch penetration into wood base.

F. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with No. 8 pan-head sheet metal screws through metal backing or metal framing behind wall finish and spaced not more than 16 inches o.c.

G. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

H. Attach sloping-top units to lockers, with end panels covering exposed ends.

I. Install number identification plates after lockers are in place.

1. Attach number identification plate on each locker door, near top, centered, with at least two screws with finish matching the plate.

J. Provide protective mat at each shoe shelf.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.

3.5 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105123

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SECTION 115213 – PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections
1. Division 5 - Metal Fabrications: Suspension systems for projection screens.
2. Section 06 40 00 - Architectural Woodwork: Wood trim for recessed screen installation.
3. Section 09 22 26 - Suspension Systems: Supports and trim for suspended ceilings.
4. Section 09 23 00 - Gypsum Plastering: Ceiling for recessed screen installation.
5. Section 09 21 16 - Gypsum Board Assemblies: Ceiling for recessed screen installation.
6. Section 09 51 00 - Acoustical Ceilings: Ceiling for recessed screen installation.
7. Division 26 for electrical wiring, connections, and installation of remote control switches for electrically operated projection screens.

B. Section Includes:
1. Electrically operated, ceiling recessed, front projection screens.

C. References
1. NFPA 70 - National Electrical Code.
2. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.
3. GREENGUARD Environmental Institute Children & Schools.
4. US Green Building Council.
5. Cradle to Cradle Certified - Cradle to Cradle Products Innovation Institute.

1.2 DEFINITIONS

A. Gain: Indication of screen’s luminance or brightness measured perpendicular to screen center and relative to magnesium carbonate block, which serves as standard for 1.0 gain. Higher numbers indicate greater brightness.

B. Viewing Angle: Horizontal angle from perpendicular center of screen at which gain or brightness decreases by 50%.

C. Format: Proportion of projection screen viewing area expressed as a ratio of height to width.
1. Square: 1.0 to 1.0
2. Cinemascope or Anamorphic Format: 1.0 to 2.35.
3. HDTV Format: 1.0 to 1.78.
4. Letterbox: 1.0 to 1.85.
5. NTSC or Video Format: 1.0 to 1.33.
6. Wide Format: 1.0 to 1.6.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Wiring diagram for electrically operated units.

D. Shop Drawings: Shop drawings showing layout and types of projection screens. Show the following:
1. Location of screen centerline.
2. Location of wiring connections.
3. Detailed drawings for concealed mounting.
4. Connections to suspension systems.
5. Anchorage details.
6. Accessories.
7. Frame details.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.5 DELIVERY, STORAGE AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction where screens will be installed is substantially complete.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Protect screens from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Base product specification by:
1. Draper, Inc., 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999

B. Other acceptable manufacturers:
1. Da-Lite Screen Company; 3100 North Detroit Street; Warsaw, Indiana 46581-0137; 800-622-3737.
2. Stewart Filmscreen Corporation; 1161 West Sepulveda Blvd.; Torrance, California 90502 800-762-4999.

2.2 MOTORIZED, CEILING RECESSED PROJECTION SCREENS

A. Screen Operation: Electrically operated, UL and ULC listed, retractable, with 1 rigid metal roller and tab guide cable screen tensioning system.

B. Motor: Housed inside metal roller and including automatic thermal overload protection, integral gears, capacitor and electric brake to prevent coasting.
1. Type: 3-wire with ground with quick connect male plug-in connector, permanently lubricated, quick reversal type designed for mounting inside roller.
2. Quantity: 1.
3. Voltage, Frequency: 115 V, 60 Hz
4. Amperage: 2.4 amps maximum.
5. Include preset, adjustable limit switches to automatically stop viewing surface in UP or DOWN position.

C. Electric Controls: Wall-mounted switch.
1. Voltage, Frequency: 115 V, 60 Hz.
2. Switch: 3 position type with cover plate for UP, DOWN and STOP functions.
3. Junction Box: Externally attached to screen case.

D. Low Voltage Control (LVC) System:
1. Single Motor Low Voltage Control (LVC) System: Internal.

E. Screen Mounting: Ceiling recessed and plenum rated type.
1. Mounting Hardware: Include mounting hardware.

F. Screen Case: Designed to receive mounting hardware and sized to suit projection screen.
1. Type 1: Extruded aluminum with heavy gage steel end caps and adjustable steel brackets.
2. Case Bottom: Self-trimming with built-in flange and equipped with concealed-hinge aluminum door for manual access.
3. Finish: White powder coated.

G. Viewing Area H x W.

1. HDTV Format (16:9). Black masking borders standard.
a. Image size per drawings.

H. Provide an extra screen drop with an overall screen drop per drawings with a black masking top border.

I. Acceptable Material: Draper, Inc. Access Fit/Series V.
1. Tab Guide Cable Tensioned Screen Material:
a. Front projection, flame retardant, mildew resistant vinyl, with black backing and with standard black borders, easily cleaned with mild soap and water solution.
b. Include tab and cable guide on each side of fabric to maintain even, lateral tension and hold viewing surface flat.
c. Bottom end of fabric to be inserted into a custom aluminum slat bar with added weight to provide vertical tension on the screen surface.
d. Slat ends to be protected by heavy-duty plastic caps enclosing a preset adjustable mechanism for screen tensioning.
e. Seamless in all sizes.

J. Gain: To SMPTE RP 94-2000, 1.1.

K. Format: HDTV - 1.78:1

L. Acceptable Viewing Surface: Draper, Inc.:
1. MATT White XT 1000V.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify rough-in openings are properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install front projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

C. Test electrically operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 115213

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SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single and double rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

B. Manufacturer's warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Limited Lifetime Warranty: Provide manufacturer's warranty against original defects in materials and workmanship for the life of the shade not to exceed 25 years from date of substantial completion.

B. Motor and Controls Warranty: Provide manufacturer's warranty for motor and control system for five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Insolroll, contact InPro/Becky Parnell, 720-256-3395 , or comparable product by one of the following:

1. Draper Inc.
2. Hunter Douglas Contract.
3. Insolroll Window Shading Systems.
4. Lu-Tek Inc.
5. MechoShade Systems, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

    a. Loop Length: Full length of roller shade.
    b. Limit Stops: Provide upper and lower ball stops.
    c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

    a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Shadeband Material: Both light-filtering fabric and light-blocking fabric; locations as indicated on Drawings.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

    a. Type: Enclosed in sealed pocket of shadeband material.

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

    a. Shape: L-shaped.

2. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

    a. Provide pocket with lip at lower edge to support acoustical ceiling panel when adjacent to suspended acoustical panel ceilings.

3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Insolroll, contact InPro/Becky Parnell, 720-256-3395, or comparable product by one of the following:

1. Draper Inc.
2. Hunter Douglas Contract.
3. Insolroll Window Shading Systems.
4. Lu-Tek Inc.
5. MechoShade Systems, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under.
2. Inside Roller:

a. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

3. Outside Roller:

a. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

D. Inside Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

E. Outside Shadebands:

1. Shadeband Material: Light-blocking fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.

2. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

a. Provide pocket with lip at lower edge to support acoustical ceiling panel when adjacent to suspended acoustical panel ceilings.

3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Woven PVC-coated fiberglass and PVC-coated polyester.
3. Weave: 2x2 Basketweave.
4. Openness Factor: 3 percent.
5. Color: As indicated on Drawings.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Fiberglass textile with PVC film bonded to both sides.
3. Features: Washable.
4. Color: As indicated on Drawings.

2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch . Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch , plus or minus 1/8 inch .

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

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SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Plastic-laminate countertops.
2. Chemical-resistant plastic-laminate countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of cutouts and holes for plumbing fixtures, soap dispensers, grommets, installed in plastic-laminate countertops.

C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each color, pattern, and surface finish.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product**.**

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on Drawings, or approved substitution by one of the following:

a. Formica Corporation.
b. Lamin-Art, Inc.
c. Panolam Industries International, Inc.
d. Wilsonart International Holdings, Inc.

D. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:

1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:

a. Nitric Acid (30 Percent): Moderate effect.
b. Sulfuric Acid (77 Percent): Moderate effect.
c. Hydrochloric Acid (37 Percent): Moderate effect.
d. Phosphoric Acid (75 Percent): No effect.
e. Acetic Acid (98 Percent): No effect.
f. Formaldehyde: No effect.
g. Ethyl Acetate: No effect.
h. Ethyl Ether: No effect.
i. Phenol (85 Percent): Moderate effect.
j. Benzene: No effect.
k. Xylene: No effect.
l. Butyl Alcohol: No effect.
m. Furfural: No effect.
n. Methyl Ethyl Ketone: No effect.
o. Sodium Hydroxide (25 Percent): No effect.

p. Sodium Sulfide (15 Percent): No effect.
q. Ammonium Hydroxide (28 Percent): No effect.
r. Zinc Chloride: No effect.
s. Gentian Violet: No effect.
t. Methyl Red: No effect.

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

a. Formica Corporation; Lab Grade 840 Black.
b. Panolam Industries International, Inc.; Pionite Chemguard.
c. Wilsonart International Holdings, Inc.; Chemsurf.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated on Drawings.

F. Edge Treatment: As indicated on Drawings.

G. Core Material: Particleboard.

H. Core Material at Sinks: Particleboard made with exterior glue or medium-density fiberboard made with exterior glue or exterior-grade plywood.

I. Core Thickness: 3/4 inch.

1. Build up countertop thickness at front, back, and ends with additional layers of core material laminated to top, thickness as indicated on Drawings.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Low-Emitting Composite Wood: Provide materials/products that have low formaldehyde emissions that meet the California Air Resources Board (CARB) ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.
2. Particleboard: ANSI A208.1, Grade M-2 and Grade M-2-Exterior Glue.

2.3 ACCESSORIES

A. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

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

a. Doug Mockett & Company, Inc.; OG Series.

2.4 MISCELLANEOUS MATERIALS

A. Low-Emitting Adhesives and Sealants: Provide products, applied on-site within the weatherproofing system, that comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content, and comply with the California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to walls with adhesive.
3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 123623.13

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Refer to Section 23 05 00. All work of Division 21 shall be in accordance with the corresponding section of Division 23, unless otherwise addressed in this Division.

END OF SECTION 210500

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SECTION 211000 - WATER BASED FIRE PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:

1. Pipe, fittings, valves and specialties.
2. Sprinklers and accessories.

B. The work of this section includes engineering by the Contractor. The Contractor shall act as Engineer of record for all fire protection work.

1.2 DEFINITIONS:

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Other definitions for fire protection systems are listed in NFPA Standards 13, 13R, 14, 20 and 24.

C. Working plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 and 14 for obtaining approval of the authority having jurisdiction.

1.3 SYSTEM DESCRIPTION:

A. Modify the fire sprinkler system for the lower level of the building (including, but not limited to, electrical rooms, mechanical penthouses and accessible sections of air handling units,) except designated areas as shown on the drawings which will not require fire sprinkler coverage will be specifically noted with "No A/S"

B. Fire protection system is a "wet-pipe" system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.

1.4 PROJECT SEISMIC REQUIREMENTS:

A. All fire protection systems shall be installed to meet NFPA requirements. Refer to structural drawings for seismic design requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.

1.5 SUBMITTALS:

A. Product data for each type sprinkler head, valve, piping and piping specialty, fire protection specialty, fire department connection and any equipment installed in accordance with the Contract Documents. Index per specification chapter and item number.

B. Shop drawings prepared in accordance with NFPA 13 identified as "working plans," including detailed riser schematics indicating pipe sizes and lengths; and hydraulic calculations where applicable, which have been approved by the authority having jurisdiction. Do not proceed with the installation of the work until the Architect/Engineer review of shop drawings is received.

C. Contractor shall stamp shop drawings indicating compliance with applicable codes and contract drawings. Contractor shall stamp drawing "Approved for Construction."

D. If more than two submittals (either for shop drawings or for record drawings) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

E. Maintenance data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection and hose valve specified, for inclusion in operating and maintenance manual specified in Division 1 and Division-23 Section "Common Work Results for Mechanical".

F. Welder's qualification certificate.

G. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Materials and Test Certificate for Underground Piping" as described in NFPA 13.

H. Provide hydraulic calculations and drawings stamped by a Registered Engineer licensed in the State where the project is located and familiar with this type of installation and with previous similar experience (practicing in the Fire Protection field) certifying that the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing codes. NICET stamps are not acceptable.

I. Fire sprinkler piping design drawings shall show all ductwork, air devices, lighting and electrical panels.

J. Shop drawings and hydraulic calculations shall be stamped and signed by the local fire prevention authority prior to submitting shop drawings to the Architect/Engineer.

1.6 HYDRAULIC DESIGN:

A. The Fire Sprinkler System shall be hydraulically calculated by the Contractor. Pipe schedule method is acceptable only as allowed in NFPA 13.

B. The wet pipe fire sprinkler system for the building shall be hydraulically calculated to comply with NFPA-13 and the following criteria:

1. Light hazard occupancy for areas unless noted otherwise.
2. Ordinary hazard occupancy for the following:

    a. Where noted or shown on drawings.
    b. Commercial Kitchens

c. Boiler Rooms

3. Hose allowance shall comply with NFPA-13.

C. The final fire protection system demand shall be a minimum of 10 PSI below the water supply curve.

D. Velocities in pipes shall be shown on hydraulic calculations. Velocities in overhead piping shall not exceed 32 feet per second. Velocities in underground piping shall not exceed 16 feet per second.

E. Allow 10 feet of loss for electric water flow switches and note on hydraulic calculations.

F. The Fire Protection Contractor shall provide as many sets of hydraulic calculations as necessary, performed and submitted to prove that the most remote and demanding areas are calculated.

G. Design information shall be permanently affixed to the main riser as described in NFPA-13.

H. Water flow data (From Previous Project) for bidding purposes only is:

1. 122 psi static
2. 120 psi residual with 530 gpm flowing

I. The Fire Protection Contractor shall be responsible for water flow data from the appropriate water department. A copy of the water flow test data from the water department shall accompany the hydraulic calculations before hydraulically calculating equipment fire sprinkler system.

J. The pipe and valve sizes indicated on the drawings and details are minimum sizes to be used regardless of sizes allowed by hydraulic calculations.

1.7 QUALITY ASSURANCE:

A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by qualified installer. The term qualified means experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with all precautions required, and has complied with all the requirements of the authority having jurisdiction. The contractor shall be licensed for the design and installation for the specific type of system in the jurisdiction where the work is to be performed and the State Colorado. Upon request, submit evidence of such qualifications to the Engineer. Refer to Division-1 Section: "Definitions and Standards" for definitions for "Installers."

B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Specifications of Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3."

C. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 13 - Standard for the installation of Sprinkler System, including applicable seismic requirements.
2. NFPA 13R - Standard for the Installation of Sprinkler Systems in residential occupancies up to four stories.

3. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
4. NFPA 24 - Installation of Private Fire Service Mains and their applications.
5. NFPA 1961 - Standard for Fire Hose.
6. NFPA 1963 - Screw Threads and Gaskets for Fire Hose Connections.
7. National Electrical Code (NEC).
8. International Building Codes, including applicable seismic requirements.
9. Requirements of the local Building Department and Fire Department.

D. Reference and standards listed are minimum requirements. Where more stringent requirements are specified or noted on the drawings, this shall be applicable.

1.8 SEQUENCING AND SCHEDULING:

A. Schedule rough-in installations with installations of other building components.

B. Minimum time frame for notice of inspections, tests and meetings is five (5) days and list the persons to be notified.

1.9 EXTRA STOCK:

A. Heads: For each style and temperature range (and length for dry heads) required, furnish additional sprinkler heads per NFPA-13.

1. Obtain receipt from Owner that extra stock has been received.

B. Wrenches: Furnish 2 spanner wrenches for each type and size of valve connection and fire hose coupling.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS:

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection systems.

B. All equipment used on this project shall be new and UL listed unless noted or specified otherwise.

2.2 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one of the following:

1. Gate Valves:

a. Nibco
b. Kennedy Valve

c. Mueller
d. Stockham
e. Grinnell
f. Milwaukee

2. Swing Check Valves:

a. Tyco Fire
b. Fivalco

3. Butterfly and Ball Valves:

a. Grinnell
b. Mueller
c. Victaulic
d. Milwaukee
e. Kennedy

4. Grooved Mechanical Couplings:

a. Victaulic Company of America

5. Sprinkler Heads:

a. Globe

6. Fire Protection Specialties:

a. Croker-Standard Div.,; Fire-End & Croker Corp.
b. Elkhart Brass Mfg. Co., Inc.
c. Grinnell Fire Protection Systems Co., Inc.
d. Grunau Sprinkler Mfgr. Co., Inc.
e. Potter Roemer, Inc.

2.3 BASIC IDENTIFICATION:

A. General: Provide identification complying with Division-23 "Identification for Mechanical Systems", in accordance with the following listing:

1. Fire Protection Piping: Pipe markers.
2. Fire Protection Valves: Valve tags.
3. Fire Protection Signs: Provide the following signs:

a. At each sprinkler valve, sign indicating what portion of system valve controls.
b. At each outside alarm device, sign indicating what authority to call if device is activated.
c. At door to each sprinkler control valves or at ceiling access points, sign reading "FIRE CONTROL".
d. At each drain or test, sign indicating its purpose.

B. Attach to the riser a metal sign indicating the name, address and telephone number of the fire protection contractor. Also indicate the date of installation.

2.4 BASIC PIPING SPECIALTIES:

A. General: Provide piping specialties complying with Division-23 “Piping Specialties", in accordance with the following listing:

1. Pipe escutcheons.
2. Dielectric unions.
3. Drip pans.
4. Pipe sleeves.
5. Sleeve seals.
6. Fire Barrier Penetration Seals.

2.5 BASIC SUPPORTS AND ANCHORS:

A. General: Provide supports and anchors complying with Division-23 "Hangers for Supports for Mechanical Piping & Equipment" in accordance with the following listing:

1. Adjustable steel clevis hangers, adjustable steel band hangers, or adjustable band hangers, for horizontal-piping hangers and supports.
2. Two-bolt riser clamps for vertical piping supports.
3. Steel turnbuckles and malleable iron sockets for hanger- rod attachments.
4. Concrete inserts, top-beam C-clamps, side beam or channel clamps or center beam clamps for building attachments.
5. Concrete inserts and other type hangers penetrating into or through structural members shall be submitted (by the Fire Protection Contractor) to and have the approval of the structural engineer contracted for this project.
6. Powder driven studs shall not be allowed.
7. Hangers (which are acceptable for project) and hanger spacing shall be in accordance with NFPA-13.

2.6 PIPE & FITTINGS (UNDERGROUND):

A. Underground pipe shall be ductile iron, thickness Class 52 unless specified otherwise by local authorities or ANSI/AWWA C150/A21.50-81; 350 psi pressure rating; tar coated outside, cement mortar lined inside in accordance with ANSI/AWWA C104/A21.4-80. Full lengths of pipe shall be utilized to the greatest extent possible.

B. Fittings for ductile iron pipe shall be 250 psi pressure rating in accordance with ANSI/AWWA C110-77, tar coated outside and cement lined inside in accordance with ANSI/AWWA C104/A21.4-80.

C. Joints shall be push-on or mechanical type as per ANSI/AWWA C111/A21.11-80.

2.7 PIPE AND TUBING MATERIALS (INSIDE BUILDING):

A. General: Refer to Part 3 Article "Pipe Applications" for identification of systems where the below specified pipe and fitting materials are used.

B. Steel Pipe: ASTM A 53, A795 or A135, Schedule 40 or Schedule 10, U.S. manufacture, black steel pipe, plain ends.

C. American Tube Company "Dyna-Thread-40" and "Dyna-Flow" and Allied Tube and Conduit Corporation "Super Flo" are acceptable to Schedule 40 pipe. Installation shall be per manufacturer's recommendations.

D. Schedule 5 pipe shall not be allowed.

E. The Corrosion Resistance Ratio of the pipe shall be 1.00 or greater. Documentation shall be presented with product submittal.

F. Schedule 10 pipe shall only be allowed for pipe sizes 2-1/2inches and larger.

G. Provide galvanized, schedule 40, piping system for preaction system and drain risers.

2.8 FITTINGS (INSIDE BUILDING):

A. Cast-Iron Threaded fittings: ANSI B16.4, Class 125 standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1. Install steel pipe with threaded joints and fittings for 2inches and smaller and where shown on drawings.

C. Steel Fittings: ASTM A234, seamless or welded, for welded joints.

D. Grooved Mechanical Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S.

E. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll- grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

F. Grooved Mechanical Fittings and Couplings for the entire fire protection system shall be of the same manufacturer as submitted in shop drawing equipment review.

G. Cast-Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt spot faced.

H. Cast Bronze Flanges: ANSI B16.24, Class 300; raised ground face, bolt holes spot faced.

I. Plain end, hooker type, or push-on fittings or couplings shall not be allowed.

J. Bushings and reducing couplings shall not be allowed.

K. UL listed and Factory Mutual approved segmentally welded fittings are acceptable. Friction loss and flow data shall accompany hydraulic calculations.

2.9 JOINING MATERIALS:

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Gasket Materials: Thickness, materials and type suitable for fluid or gas to be handled, and design temperatures and pressures.

2.10 GENERAL DUTY VALVES:

A. Gate Valves - 2 Inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.

B. Gate Valves - 2-1/2 Inch and Larger: Iron body; bronze mounted, 175 pound cold water working pressure - non-shock. Valves shall have solid taper wedge; outside screw and yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A 126 Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting f a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open.

C. Butterfly Valves: 2-1/2inches to 12inches, grooved, ductile iron body and disc ASTM-536, disc EPDM coated, listed and approved minimum 175 psi service, actuator, self-contained supervisory switch, weatherproof approved for indoor or outdoor use.

D. Ball Valves: 1-1/2inches and smaller shall be threaded, forged brass construction, with Teflon seats and blow out proof stem. Ball shall be full port with chrome plated ball.

E. Ball Valves: 2inches to 3inches shall be listed to 300 p.s.i. with optional internal tamper switch. Body shall be ductile iron with corrosion resistant coating. Ball shall be 316 stainless steel, standard port design.

F. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

2.11 SPECIALTY VALVES:

A. Emergency Pull Box: Metal enclosure, labeled with "Manual Emergency Station" and operating instructions, complete with union, 1/2 inch pipe nipple and bronze ball valve. The enclosure cover shall be held closed by a breakable strut, which prevents accidental opening and must be replaced after each opening.

B. Preaction Valves: Preaction systems shall have valves specifically listed for preaction service.

2.12 BASIC METERS AND GAUGES:

A. General: Provide meters and gauges complying with Division- 23 "Meters and Gauges for Mechanical Piping", in accordance with the following listing

1. Pressure gauges, 0-250 psi range.

2.13 ALARM DEVICE AND FIRE PROTECTION SPECIALTIES:

A. General: Provide fire protection specialties, UL-listed, in accordance with the listing. Provide sizes and types which mate and match piping and equipment connections.

B. Water Flow Indicators: Vane type water flow detector, rated to 250 psig; designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 volts DC; complete with factory-set field-adjustable retard element to prevent false signals, tamper-proof cover which sends a signal when cover is removed, and with activation time retarding capability set at 30 seconds. The setting shall be verified through the inspectors test prior to final inspection.

C. Supervisory Switches: Provide products recommended by manufacturer for use in service indicated. SPST, normally closed contacts, designed to signal valve in other than full open position.

D. Pressure Switch: Indicating low pressure trouble in sprinkler system.

E. Pressure switch: Indicating flow in sprinkler system.

2.14 AUTOMATIC SPRINKLERS:

A. Sprinkler Heads: Fusible link or frangible bulb type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal ½ inch discharge orifice, for "ordinary" temperature range with a minimum temperature of 155 degrees F. Provide "intermediate" temperature heads in Electrical rooms, where required as noted in NFPA 13, and as required by the Authority having jurisdiction.

B. Sprinkler Head Finishes: Provide heads with the following finishes:

1. Upright, Pendent and Sidewall Styles: Factory brass, rough bronze finish for heads in unfinished spaces. Heads shall be stainless steel where installed exposed to acids, chemicals, or other corrosive fumes.
2. Concealed Style: Rough brass, adjustable, with painted white cover plate in finished spaces. Recessed Style: Bright chrome, with bright chrome escutcheon plate.
3. See drawings for additional sprinkler type requirements.

C. Sprinkler Head Cabinet and Wrench: Finished steel cabinet, suitable for wall mounting, with hinged cover and space for spare sprinkler heads plus sprinkler head wrench. Provide amounts of each style per NFPA-13. Locate head cabinet on shop drawing submittal.

D. Plastic fire sprinkler escutcheons are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine rough-in for fire hose valves and cabinets to verify actual locations of piping connections prior to installing cabinets.

B. Examine walls for suitable conditions where cabinets are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS:

A. Install Schedule 40 steel pipe with threaded joints and fittings for 2 inches and smaller.

B. Install Schedule 40 steel pipe with roll-grooved ends and grooved mechanical coupling or with threaded joints and fittings.

3.3 PIPING INSTALLATIONS:

A. Provide a minimum 5feet-0inches cover for all underground pipe installations. Install in accordance with AWWA C600.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated. Drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.

1. Deviations from approved "working plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "working plans."

C. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

D. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Welded outlet branch pipe fittings are acceptable.

E. Install unions in pipe 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

F. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

G. For welded pipe, all cutouts (coupons) shall be removed prior to installation.

H. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.

I. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.

J. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls. Refer to Division 23 Section "Common Work Results for Mechanical."

K. All piping penetrating walls to structure shall be sleeved and sealed per specification Section 23 05 09 “Mechanical Fire Stopping” and Section 23 05 18 “Piping Specialties”.

L. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

M. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than ¼" and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.

N. The fire line entry valves shall have monitoring electrical switches, the wiring from which shall be carried to the fire annunciating panel.

O. The fire protection contractor shall be responsible for the coordination of his installation with all other contractors. See Section 23 05 00 for prioritized components.

P. Protect adjacent area where pipe cutting and threading takes place (e.g. floors, ceilings, walls, etc.).

Q. There shall be no fire sprinkler piping in electrical rooms (with the exception of piping serving sprinklers directly in that room) or piping installed over any electrical panels.

R. Provide spring-loaded check valve at top of drain risers.

S. Install pressure gauges on city and system sides of fire entry valve assembly.

T. Install hangers straight and true and piping parallel to building lines.

3.4 PIPE JOINT CONSTRUCTION:

A. Welded Joints: AWS D10.9, Level AR-3.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads.
4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings.

E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.5 VALVE INSTALLATIONS:

A. General: Install fire protection specialty valves, fittings and specialties in accordance with the manufacturer's written instructions, NFPA 13 and the authority having jurisdiction.

B. Gate Valves: Install electronically supervised-open indicating valves so located to control all sources of water supply except fire department and roof manifolds connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Division-23 Section "Identification for Mechanical Systems" for valve tags and signs.

3.6 SPRINKLER HEAD INSTALLATIONS:

A. Any sprinkler heads with any paint on them shall be replaced. The sprinkler system shall then be hydrostatically tested again at the contractor's expense.

B. Sprinkler heads shall be positioned so as to comply with NFPA-13 for any obstructions. This includes, but is not limited to, soffits, surface mounted lights and indirect lighting arrangements. The Fire Protection Contractor is responsible for identifying these obstructions and designing the system accordingly.

C. Run piping concealed above heated furred ceilings and in joists to minimize obstructions. Expose only heads.

D. Protect exposed sprinkler heads against mechanical injury with standard guards. Provide sprinkler head guards in all mechanical, electrical or storage rooms as well as exposed pendant heads which are installed less than 8feet-0inches A.F.F.

E. Provide 1 inch diameter nipple and 1 inch x 1/2 inch reducing fitting for each upright head. (Excluding mechanical equipment rooms.)

F. Provide heads in "pocketed" areas caused by exposed duct, piping or beams.

G. Sprinkler head deflector distance from face of finished ceiling shall not exceed 4inches.

H. Sprinkler heads shall be located in the center of all 2 foot x 2 foot ceiling tiles and quarter points, along the center line lengthwise of 2 foot x 4 foot ceiling tiles.

I. Use proper tools to prevent damage during installations.

J. Install sprinkler piping in a manner such that mechanical equipment, ceiling tiles or lights can be accessed and easily removed. The sprinkler piping shall be installed to provide a minimum of 6inches above the top of a finished ceiling.

K. Minimum fire sprinkler head temperature rating for sprinklers in electrical rooms shall be 212 degrees F. Keep sprinklers as far from transformers and/or panels as spacing allows.

3.7 INSTALLATION OF BASIC IDENTIFICATION:

A. General: Install mechanical identification in accordance with Division-23 Identification for Mechanical Systems”.

B. Install fire protection signs on piping in accordance with NFPA 13 and NFPA 14 requirements.

3.8 INSTALLATION OF METERS AND GAUGES:

A. Install meters and gauges in accordance with Division-23 "Meters and Gauges for Mechanical Piping".

3.9 FIELD QUALITY CONTROL:

A. Flush, test and inspect sprinkler piping systems in accordance with NFPA 13, Standard for installation of sprinkler systems.

B. The fire sprinkler system shall not be connected to underground piping until the fire service main is tested and approved.

C. The Fire Protection Contractor shall conduct and bear the costs of all necessary tests of the fire protection work, furnish all labor, power and equipment. All piping shall be tested with water as required, the tests witnessed by the authority having jurisdiction.

D. The fire protection piping shall be tested under a hydrostatic pressure of not less than 200 psig, for a duration of not less than 2 hours.

E. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system at Fire Protection Contractor's expense.

F. All piping tests (pneumatic and hydrostatic) shall be conducted prior to the application of any painting materials. This will prevent hidden leaks and/or repainting of repaired/altered piping.

3.10 SYSTEM CERTIFICATION:

A. The Contractor shall provide the Owner with written certification prior to final inspection, that all new equipment:

1. Has been visually inspected and functionally tested as required by the Specifications.
2. Is installed entirely in accordance with the manufacturer's recommendations within the limitations of the system's UL listings and NFPA criteria.
3. Is in proper working order.

3.11 FINAL INSPECTION AND TESTING:

A. The Contractor shall make arrangements with the Owner for final inspection and witnessing of the final acceptance tests. The Fire Protection Contractor, the Alarm System Contractor and the Owner will conduct the final inspection and witness the final acceptance test.

B. All tests and inspections required by the referenced Codes and Standards, and the Owner shall be performed by the Contractor.

C. The inspecting committee as referenced above will visit the job site to inspect the work and witness the final acceptance tests when they have been advised by the Contractor that the work is completed and ready for test. If the work is not complete or the test is unsatisfactory, the Contractor shall be responsible for the Consultant's extra time and expenses for re-inspection and witnessing the re-testing of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.

D. After the system has been inspected and tested, a certificate, "Contractor's Material and Test Certificate Sprinkler System - Water Spray System," shall be provided by the contractor and shall be signed by him or his representative, the Owner's representative and by a representative of the fire department if appropriate. Sufficient copies shall be prepared to ensure the Engineer, Owner, all inspecting authorities and the contractor have a copy for their files. The Contractor shall prepare one (1) test report for each inspection performed whether successful or not.

E. The signing of the certificate by the Owner's representative shall in no way prejudice any claim against the contractor for faulty material, poor workmanship, or failure to comply with inspecting authority's requirements or local ordinances.

F. Contractor shall provide at least five (5) working days' notice for all tests.

G. All sprinkler supervisory initiating devices shall be functionally tested to verify proper operation.

H. All supervisory functions of each initiating device shall be functionally tested.

I. Receipt of all alarm and trouble signals, initiated during the course of the testing, shall be verified at the fire alarm control panel.

3.12 WORK BY OTHERS:

A. Wiring of all water flow switches and tamper switches on valves to central alarm panel are by Division 26.

3.13 OPERATION AND MAINTENANCE MANUAL:

A. The Contractor shall provide the Owner with a loose-leaf manual containing:

1. A detailed description of the systems.
2. A detailed description of routine maintenance required or recommended or which would be provided under a maintenance contract including a maintenance schedule and detailed maintenance instructions for each type of device installed.
3. One copy of NFPA-25.
4. Manufacturers' data sheets and installation manuals/instructions for all equipment installed.
5. A list of recommended spare parts.
6. Service directory, listing the specific equipment items and where parts can be obtained, with name, address and telephone number.
7. Full size sepias of the record drawings (stamped and signed per section 1.6).
8. Hydraulic calculations (stamped and signed per section 1.6).
9. Test certificates.

B. Refer to Division 1 and Section 23 05 00 "OPERATING AND MAINTENANCE" for additional requirements.

C. Within 15 days of the completion of the work, six (6) copies of the manual shall be submitted for approval.

3.14 RECORD DRAWINGS:

A. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawing prints which shall be marked to show each and every change made to the sprinkler system from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings approved by the Owner without written instruction from the Owner in each case. This set of drawings shall be used only as a record set.

B. Upon completion of the work, the record set of prints shall be used to prepare complete, accurate final record drawings reflecting any and all changes and deviations made to the sprinkler system.

C. The Owner, at his option and at the Contractor's expense, may require revised hydraulic calculations depending on the extent and nature of field changes.

D. The Record Drawings and Hydraulic Calculations shall have the signed stamp of a professional engineer registered in the State of Colorado certifying the Record Drawings and the Hydraulic Calculations accurately represent the completed fire protection system.

E. Upon completion of the work, two sets of blueline record drawings shall be submitted to the Owner for review.

F. Upon review of the blueline record drawings, before final approval, one (1) set of reproducible mylar record drawings and four (4) additional sets of blue line record drawings shall be delivered to the Owner.

3.15 GUARANTEE PERIOD:

A. Guarantee: The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by him (or his subcontractors) or by defects in his (or his subcontractors') work, materials, or equipment.

B. Emergency Service: During the installation and warranty period, the Contractor shall provide emergency repair service for the sprinkler system within four hours of a request by the Owner for such service. This service shall be provided on a 24 hour per day, seven days per week basis.

3.16 TRAINING:

A. The Contractor shall conduct two (2) training sessions of four (4) hours each to familiarize the building personnel with the features, operation and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a time mutually agreeable to the Contractor and the Owner.

3.17 WATER DAMAGE:

A. The Fire Protection Contractor shall be responsible for any damage to the work of others, to building and property/ materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings, and shall pay for necessary replacement or repair

of work or items so damaged during the installation, testing or guarantee periods of the automatic sprinkler work.

END OF SECTION 211000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Refer to Section 23 05 00. All work of Division 22 shall be in accordance with the corresponding section of Division 23, unless otherwise addressed in this Division.

END OF SECTION 220500

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SECTION 221110 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This Section specifies the water distribution piping system, including potable cold, hot, and recirculated hot water piping, fittings, and specialties within the building to a point 5 feet outside the building.

B. Products installed but not furnished under this Section include water meters which will be provided by the utility company, to the site, ready for installation.

C. Related Sections: The following Sections contain requirements that relate to this section.

1. Refer to Division 2 for below grade water service piping from public utility water main to building.
2. Refer to Division 2 for trenching and backfilling materials and methods for underground piping installations.
3. Refer to other Division 23 sections for piping materials; methods for sealing pipe penetrations through basement walls and fire and smoke barriers; thermometers, flow meters and pressure gauges; mechanical identification; plumbing pumps; dielectric unions, strainers and pressure regulating valves.

1.2 DEFINITIONS:

A. Water Distribution Piping: A pipe within the building or on the premises which conveys water from the water service pipe or meter to the points of usage.

B. Water Service Piping: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.

C. Pipe sizes used in this specification are Nominal Pipe Size (NPS).

1.3 SUBMITTALS:

A. Refer to Division 1 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.

B. Provide data for each piping specialty and valve specified.

C. Certification of Compliance with ASME, NSF-61 and UL fabrication requirements.

D. Test reports as specified in Part 3 of this section.

E. Manufacturer and product data for lead free solder with material breakdown.

F. Maintenance data for each piping specialty and valve specified for inclusion in operation and maintenance manual specified in Division 23.

1.4 QUALITY ASSURANCE:

A. Regulatory Requirements: Comply with the provisions of the following:

1. International Plumbing Code, currently adopted version.
2. NSF Standard 61: "Drinking Water System Components."
3. ASME B 31.9 "Building Services Piping" for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
4. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for Qualifications for Welding Processes and Operators.
5. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of water distribution systems.
6. Local Utility Department requirements.
7. Local Cross Connection Control Manual.
8. //Latest edition of the Engineering Standards of the Denver Board of Water Commissioners.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Store pipe in a manner to prevent sagging and bending.

B. Cap ends of piping when being stored.

C. Store all materials per the manufacturer’s recommendations.

1.6 SEQUENCING AND SCHEDULING:

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement and formwork requirements are specified in Division 3.

B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.7 EXTRA STOCK:

A. Maintenance Stock: Furnish one valve key for each key operated wall hydrant, hose bibb or faucet installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Domestic Hot Water Automatic Balance Valves:

a. Therm-Omega-Tech Circuit Solver

2. Shock Arresters:

a. Precision Plumbing Products
b. Sioux Chief

2.2 PIPE AND TUBE MATERIALS:

A. General: Provide pipe material and pipe fittings complying with Division 23.

2.3 BASIC SUPPORTS AND ANCHORS:

A. General: Provide supports and anchors complying with Division 23.

2.4 GENERAL DUTY VALVES:

A. General: Provide valves complying with Division 23.

2.5 DOMESTIC HOT WATER AUTOMATIC BALANCE VALVES:

A. Self-contained and fully automatic without additional piping or control mechanisms.

B. Valve shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.

C. When fully closed, valve shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.

D. Factory adjustable from 105°F to 140°F as required by project conditions.

E. Shall modulate between open and closed position within a 10°F range.

F. Sizes ranging from 1/2-inch NPT to 2-inch NPT.

G. Body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.

H. Rated to 200 PSIG maximum working pressure.

I. Standard tapered female pipe thread, NPT.

J. Rated to 300°F maximum working temperature.

K. ANSI/AWWA C800 compliant.

L. NSF-61 compliant with zero lead content for use in all domestic water systems.

M. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.

N. Thermal actuator shall be rated for a minimum of 200,000 cycles.

2.6 PIPING SPECIALTIES:

A. Shock Arresters - Piston Type: 60 psi precharge, sealed from system water with free sliding piston and EPDM O-rings. Suitable for up to 150 psi and 180 degrees F, threaded connection. Shock arresters shall be ASSE 1010 certified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes & regulations, the original design and the applicable referenced standards.

B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION:

A. Refer to Division 23 for materials and methods for installation of piping.

B. Install shock arresters in hot and cold domestic water piping systems on each set of flush valves, quick closing type valves and other locations where hydrostatic shock pressures could occur.

3.3 HANGERS AND SUPPORTS:

A. Refer to Division 23 for installation of supports and anchors.

3.4 PIPE AND TUBE JOINT CONSTRUCTION:

A. Refer to Division 23 for materials and methods for pipe joints.

3.5 VALVE APPLICATIONS:

A. General Duty Valve Applications: The drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:

1. Shut-off duty: Use gate, ball and butterfly valves.
2. Throttling duty: Use globe, ball and butterfly valves.

3.6 INSTALLATION OF VALVES:

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as

indicated. For sectional valves 2” and smaller, use gate or ball valves; for sectional valves 2-½” and larger, use gate or butterfly valves.

B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on inlet of each plumbing fixture and elsewhere as indicated. For shutoff valves 2” and smaller, use ball valves; for shutoff valves 2-½” and larger, use gate or butterfly valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to completely drain equipment for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to completely drain distribution piping system. For drain valves 2” and smaller, use ball valves; for drain valves 2-1/2” and larger, use gate or butterfly valves.

D. Check Valves: Install non-slam spring loaded check valves on discharge side of each pump and elsewhere as indicated. See Division 23 for valve application.

E. Balance Cocks: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.

3.7 INSTALLATION OF PIPING SPECIALTIES:

A. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, clinical service sinks, dishwashers, disposals, clothes washers, ice makers, auto claves, pre-rinse spray hose, etc. Install in accessible location. Refer to detail on drawings. Provide access doors in accordance with architectural recommendations if an isolation valve is installed.

1. Units shall be sized in accordance with the following schedule.

Drawing Designation	Fixture Unit Rating	P.D.I. Size
SA-1	1-11	A
SA-2	12-32	B
SA-3	33-60	C
SA-4	61-113	D
SA-5	114-154	E
SA-6	155-330	F

3.8 DOMESTIC HOT WATER AUTOMATIC BALANCE VALVES:

A. Install as indicated on drawings and in each domestic hot water return piping branch beyond last hot water device in that branch.

B. Provide suitable line size isolation valves, unions, and other components as indicated in piping detail shown on the drawings.

C. Provide suitable access panel as required in non-accessible ceilings and walls.

3.9 EQUIPMENT CONNECTIONS:

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code. For fixtures with hot water service, extend hot water recirculation line out to fixtures greater than 20’ away from main or loop hot water line down to the fixture.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection, provide drain valve on drain connection. Provide back-flow preventer as shown as required. For connections 2-1/2” and larger, use flanges instead of unions.

3.10 FIELD QUALITY CONTROL:

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the Local Authority Having Jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

    a. Rough-in Inspection: Arrange for inspection of the piping system after the system is roughed-in but before concealing or closing in piping and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.

3. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Test water distribution piping as follows:

1. Refer to Division 23 for materials and methods for performing pipe tests.

3.11 ADJUSTING AND CLEANING:

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended or repaired prior to use.
2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, AWWA C652 or as described below:

    a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.

c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system.
e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities.

3.12 COMMISSIONING:

A. Fill the system.

B. Check compression tanks to determine that they are not air bound and that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position. Close drains, valves, hydrants and sill cocks.
2. Remove and clean strainers.
3. Check pump for proper direction of rotation. Correct improper wiring.
4. Lubricate pump motors and bearings.

END OF SECTION 221110

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SECTION 221319- SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This Section specifies building sanitary drainage, storm drainage, drainage specialties and vent piping systems.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Refer to Division 23 sections for trenching and backfilling materials and methods for underground piping installations
2. Refer to Division 2 Section for sanitary drainage piping within the building to a point 5 feet outside the building
3. Foundation Drain Piping: Not work of this section.
4. Refer to other Division 23 sections for piping materials & methods, sealing pipe penetrations through basement & foundation walls, fire & smoke barriers and mechanical identification.

1.2 DEFINITIONS:

A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste and other drainage pipes inside the walls of the building and conveys it to the building sewer to a point 5’-0” outside the building wall.

B. Building Sewer: That part of the horizontal piping of a drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems, private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

E. See legend on drawings for additional information.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for all plumbing items including the model clearly indicated, operating weights, furnished specialties & accessories and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, required clearances and methods of assembly of components.

C. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.

D. Maintenance Data: Submit maintenance data and parts lists for each type of drain and accessory, including "trouble-shooting" maintenance guide. Include this data, product data and shop drawings in maintenance manual and in accordance with requirements of Division 23.

1.4 QUALITY ASSURANCE:

A. Regulatory Requirements: Comply with the provisions of the following:

1. Plumbing Code Compliance: Comply with applicable portions of Local Plumbing Code.
2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products and installation of soil and waste systems.
3. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of soil and waste systems.
4. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems.
5. PVC, CPVC and PVDF Pipe: Only Contractor's personnel which have received training in the installation of this material and meet the manufacturer's qualifications shall do the assembly of such material.

1.5 SEQUENCING AND SCHEDULING:

A. Coordinate the installation of roof drains, flashing and roof penetrations.

B. Coordinate flashing materials installation of roofing, waterproofing and adjoining substrate work.

C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing and slope of slab to drains.

D. Coordinate with installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems.

E. Coordinate all penetrations with Structural Engineer.

F. Coordinate all installations with work of other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide drainage and vent systems from one of the following:

1. Drainage Piping Specialties, including backwater valves, expansion joints, drains, cleanouts and trap primers:

a. Zurn Industries

2.2 SANITARY AND STORM DRAINAGE, VENT AND SUBSURFACE DRAINAGE PIPE AND FITTINGS:

B. General: Provide piping and pipe fittings complying with Division 23.

2.3 BASIC SUPPORTS AND ANCHORS:

C. General: Provide supports and anchors complying with Division 23.

2.4 CLEANOUTS:

D. Cleanout Plugs: Cast brass, threads complying with ANSI B2.1 and local plumbing code.

E. Floor Cleanout: Round, cast iron body with recessed bronze closure plug; scoriated polished bronze frame and cover plate.

F. Wall Cleanout: Cleanout tee with raised head brass plug tapped for 1/4-20 thread; flat style chrome plated wall cover plate with holes for ¼-inch bolt; 1/4-20 threaded bolt with chrome plated flat head.

G. Surface Cleanout: Cast iron body ferrule with raised head brass plug. Medium duty cast iron manhole cover and ring 12-inch diameter to be set in concrete pad, Neenah No. R-1791-A.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. General: Install piping in accordance with local Authority Having Jurisdiction (AHJ), except where more stringent requirements are indicated.

B. Inspect piping before installation to detect apparent defects. Mark defective materials and promptly remove from site.

C. Verify all dimensions by field measurements. Verify that all drainage, vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design and referenced standards.

D. Verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to installations.

E. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

F. Examine walls, floors, roof and plumbing chases for suitable conditions where piping and specialties are to be installed.

G. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FOUNDATION PREPARATION FOR UNDERGROUND BUILDING DRAINS:

A. Refer to Division 23 for trenching and backfill requirements.

3.3 INSTALLATION:

A. General Locations and Arrangements: Drawings (plans, schematics and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.

B. Install overflow roof drains with the inlet flow line located a maximum 2 inches above the lowest point of roof.

C. All floor drains are to be provided with P-trap the same size as the floor drain unless otherwise noted on mechanical drawings.

D. Provide flashing membrane for all floor drains in structure above slab on grade level; see flashing detail on mechanical drawings.

E. Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, relubricate and reinstall using only enough force to ensure permanent leakproof joint.

F. Provide flashing for all floor drains, floor cleanouts in wet areas and shower drains above grade. Make watertight with underslab moisture vapor barrier. Refer to Division 7 for requirements of vapor barriers. Flashing shall extend at least 24-inches from drain rim into floor membrane or on structural floor. Fasten flashing to drain clamp device and make watertight, durable joint. Provide flashing collar extension with all drains and cleanouts installed above grade.

3.4 HANGERS AND SUPPORTS:

A. General: Refer to Division 23 for supports and anchors.

3.5 INSTALLATION OF PIPING SPECIALTIES:

A. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and extend cleanouts to floor or wall above. Line cleanouts are not acceptable unless otherwise noted on the drawings.

1. As required by plumbing code;
2. At each change in direction of piping greater than 135 degrees below slab;
3. At each change of horizontal direction greater than 45 degrees in horizontal drainage pipe;
4. At minimum intervals of 100 feet;
5. At base of each vertical soil or waste stack;
6. At sinks and urinals on grade;
7. At egress of building (surface cleanout).
8. At each toilet group.

B. Cleanouts Covers: Install floor and wall cleanout covers, types as indicated, and in accessible locations.

C. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

D. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.6 PIPE AND TUBE JOINT CONSTRUCTION:

A. Install pipes and pipe joints in accordance with Division 23.

3.7 SERVICE CONNECTIONS:

A. Provide new sanitary/storm 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.

B. Provide all necessary piping and connections from building drain/storm drain system to connection of sewer systems 5’-0” outside building.

3.8 CONNECTIONS:

A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.9 FIELD QUALITY CONTROL:

A. Piping System Test: Test drainage and vent system in accordance with the procedures of the local Authority Having Jurisdiction, or in the absence of a published procedure, as described in Division 23.

B. Inspections:

1. Do not enclose, cover or put into operation drainage and vent piping system until it has been pressure tested, inspected and approved by the local Authority Having Jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified in Division 23 in the presence of the plumbing official.

    a. Rough-in Inspection: Arrange for inspection of the piping system before concealing or closing in after system is roughed-in, and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection to observe the tests specified and to ensure compliance with the requirements of the plumbing code.

3. Re-inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports, signed by the plumbing official.

3.10 ADJUSTING AND CLEANING:

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.11 PROTECTION:

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops. Piping shall not be left open ended during construction.

C. Exposed PVC, CPVC and PVDF Piping: Protect plumbing vents exposed to sunlight with 2 coats of water based latex paint. Color selection shall be by Architect.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of plumbing fixtures work required by this section is indicated on drawings, schedules and by specified requirements of this section.

B. See Plumbing Fixture Schedule on drawings for types of fixtures specified.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:

1. International Plumbing Code.
2. NSF Standard 61: "Drinking Water System Components."
3. ASHRAE Standard 18: "Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration."
4. ARI Standard 1010: "Self Contained, Mechanically Refrigerated Drinking Water Coolers."
5. UL Standard 399: "Drinking Water Coolers."
6. Colorado Drinking Water Act – Current Addition.
7. Colorado Department of Public Health and Environment Regulations.
8. Colorado Cross-Connection Control Manual: “Current Edition.”
9. ANSI Standard A117.1: "Standard on Accessible and Usable Buildings and Facilities."
10. Accessibility Guidelines and Standards of the United States Access Board.
11. Current Appliance and Equipment Standards of the United States Department of Energy.

B. Where fixtures are indicated on the architectural drawings and intended to be ADA compliant, it shall be the sole responsibility for all manufacturers and/or suppliers to provide plumbing fixtures and related trim which meets the ADA requirements. Such indication may be shown by note on floor plans or schedules, by clearance dimensions or areas on the plans or other graphics or notes on elevations.

1.3 SUBMITTALS:

A. Product Data: Submit product data and installation instructions for each fixture, faucet, specialty, accessory and trim specified or shown on plumbing fixture schedule; clearly indicate rated capacities of selected models.

B. Shop Drawings: Submit rough-in drawings with brand names on each sheet and item. Detail dimensions, rough-in requirements, required clearances and methods of assembly of components and anchorages. Coordinate requirements with architectural casework shop drawings specified in Division 6 for fixtures installed in countertops and cabinets. Furnish templates for use in casework shop drawings.

C. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field

installed. Coordinate and provide matrix of mechanical and electrical requirements as specified in Division 22.

D. Color Charts: Coordinate fixture color with Architect and submit manufacturer's standard color charts for cabinet finishes and fixture colors.

E. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured plumbing fixture, valve and trim. In addition to providing in the submittals, include this data, product data and shop drawings with operations and maintenance manuals.

F. Submit certification of compliance with specified performance verification requirements and IPC, NSF, ANSI, UL and ASHRAE Standards.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer’s recommended temperatures to prevent damage.

B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim. Keep covered and protected at all times.

1.5 SEQUENCING AND SCHEDULING:

A. Schedule rough-in installations with the installation of other building components. Provide access as required or as shown in the manufacturer’s guidelines.

1.6 MAINTENANCE:

A. Extra Stock:

1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one device for each 10 fixtures, minimum of one wrench and one device.
2. For each type of faucet, furnish faucet repair kits complete with all necessary washers, springs, pins, retainers, packings, O-rings, sleeves, cartridges and seats in a quantity of 1 kit for each 20 faucets, minimum one repair kit per faucet type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer subject to compliance with requirements, provide products by one of the following specified manufacturers:

1. Stainless Steel Sinks:

a. Elkay
b. Just

2. Faucets:

   a. American Standard

3. Fixture Supplies, Stops & Traps:

   a. McGuire

4. Under Lavatory/Sink Protective Pipe Covers:

   a. True Bro

2.2 FIXTURES:

A. Stainless Steel Sinks

1. Material: Type 304, 18-gauge stainless steel.
2. Fixture Color: No. 4 satin finish for stainless steel. White, for enameled cast iron, unless specifically specified otherwise. Composites only as specified.
3. Mounting: Wall mounted and carrier mounted sinks shall be installed per manufacturer recommendations and instructions.
4. Faucet hole drillings shall match the faucet configuration and accessories specified in the mechanical and architectural documents, i.e. dishwasher air gaps, liquid dispensers, remote drain operators, eye washes, etc. when mounted in the sink back ledge. Note: Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering sinks.
5. Stainless steel sinks to be sound deadened with undercoating.

2.3 FAUCETS:

A. Sink Trim

1. All sink faucets shall be provided with ¼-turn handles, laminar flow controls in lieu of aerators.
2. All sink faucets shall be provided with ceramic disc cartridges.
3. Alternate faucet controls, i.e. self-closing, knee operated, foot operated, etc. shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
4. All sink faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district. Types include hand, foot, knee, infra-red or heat sensing type operations.
5. Infrared faucets must be provided with integral stops.

2.4 FITTINGS, TRIM, AND ACCESSORIES:

A. Provide ¼-turn convertible angle stops whether angle or straight for all applications

B. Stops and Supplies for Lavatories and Sinks: Polished, chrome-plated, brass ball and stem, loose key, angle stop having ½” inlet and 3/8" O.D. x 12" long chrome plated copper supply riser or braided stainless steel flexible tubing; outlet with collar, wall flange and escutcheon. Quantity to match trim specified. Deliver all handles to Owner.

C. Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of fixture.

D. Sink Strainers: All sink strainers shall be “Spin-N-Grin” type models unless specifically specified otherwise.

E. Traps for Sinks: 17-gauge, chrome-plated tubular brass, 1-1/2" or 2” adjustable "P" trap and waste to wall with escutcheon.

F. Escutcheons: Chrome-plated cast brass, one piece with set screw.

G. All ADA accessible lavatories and sinks shall have the supply and waste piping insulated with under lavatory/sink ADA covers.

2.5 UNDER LAVATORY/SINK PROTECTIVE PIPE COVERS:

A. ADA Accessible Lavatories and Sinks: Provide white, molded antimicrobial vinyl cover for stops, supplies, trap and tailpiece.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with codes & regulations, the intended design and the referenced standards.

B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install plumbing fixtures level and plumb in accordance with fixture manufacturer's written instructions, rough-in drawings, codes & regulations, the intended design and the referenced standards.

B. All wall hung fixtures shall be supported from the building structure with floor mounted carriers. Do not support from walls.

C. Install fixture water stop valves in accessible locations. Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of the fixture.

D. Provide cleanouts as shown on drawings or per the applicable Plumbing Code.

E. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork. Seal pipe penetration prior to installing. Use correct size of escutcheon to cover entire opening.

F. Seal fixtures to walls and floors using non-hardening silicone sealant with coved finish as specified in Division 7. Match sealant color to fixture color, except for stainless steel sinks.

G. Chrome plated cap nuts for wall hung fixtures shall be installed with strap wrench to prevent marring.

H. Fixtures shall be product of one manufacturer and must be manufactured in the USA per Division 22.

3.3 ADA ACCESSIBILITY:

A. Review Mechanical and Architectural drawings to determine fixtures requiring ADA accessibility. Notify Architect/Engineer of any physical conflicts preventing full dimensional compliance prior to beginning work.

B. Comply with the installation requirements of ANSI A117.1 and “Accessibility Guidelines and Standards of the United States Access Board” with respect to plumbing fixtures for the physically handicapped. Arrange flush valve/flush tank handles with proper orientation to meet ADA requirements.

3.4 FIELD QUALITY CONTROL:

A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.

B. Inspect each installed unit for damage. Replace damaged fixtures.

3.5 ADJUSTING:

A. Adjust water pressure at drinking fountains, faucets and shower valves to provide proper flow and stream. Contractor shall adjust flush valve to proper flow rate for appropriate wash and flush water volume to match the intended flush action for the installed units.

B. Replace leaking or dripping faucets and stops.

3.6 CLEANING:

A. Clean fixtures, trim and strainers using manufacturer's recommended cleaning methods and materials prior to final turnover to Owner.

3.7 PROTECTION:

A. Provide protective covering for installed fixtures and trim as required by this section.

B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

3.8 FIXTURE MOUNTING HEIGHT SCHEDULE:

A. Fixture mounting height and rough-in dimensions shall be per ADA requirements or as indicated on the architectural drawings and specifications.

3.9 WATER CONSERVATION:

A. All plumbing fixtures shall be of water conservation design per the US EPA WaterSense flow rates required by Colorado Law as of September 1, 2016. Maximum water flow rates shall be as follows:

1.	Flush Valve Toilets	1.28 Gallons per Flush
2.	Lavatories	1.50 Gallons per Minute
3.	Bathroom Sinks	1.50 Gallons per Minute
4.	Urinals	0.50 Gallons per Flush

B. Other fixtures not required to comply with US EPA WaterSense:

1.	Sinks	2.20 Gallons per Minute
2.	Janitor Sinks or Mop Basins	2.20 Gallons per Minute

C. Refer to Plumbing Fixture Schedule on drawings for specified water flow rates for each fixture type on this project.

D. Lower water flow rates are permissible.\

E. All plumbing fixtures shall be of water conservation design per the current water conservation measures. As a minimum, provide devices to restrict water flow as follows unless scheduled otherwise:

1.	Lavatory	2.20 Gallons per Minute
2.	Sink	2.20 Gallons per Minute
3.	Water Closets	1.60 Gallons per Flush
4.	Urinals	1.00 Gallons per Flush
6.	Janitor Sinks or Mop Basins	2.20 Gallons per Minute

F. Refer to Plumbing Fixture Schedule on drawings for specified water flow rates for each fixture type on this project.

G. Lower water rates are permissible.

END OF SECTION 224000

SECTION 226000 – GAS AND VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of medical gas systems equipment and products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer Qualifications: Firm with at least 3 years of successful installation experience on projects with medical gas systems work similar to that required for project.

1. Individual installers shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX as modified by NFPA 99.
2. On site supervisors shall have completed a 32 hour training course on the installation of medical gas systems in accordance with ANSI requirements.

C. Codes and Standards:

1. NFPA Compliance: Install and test medical gas systems in accordance with the currently adopted version of NFPA 99.
2. ASME Compliance: Provide medical gas pressure vessels and relief valves in accordance with ASME "Boiler and Pressure Vessel Code"; provide ASME Code Symbol Stamp.
3. ASME Compliance: Fabricate and install medical gas systems in accordance with ASME B31.9 "Building Service Piping".
4. UL Compliance: Provide electrical components which are UL-listed and have UL label affixed.
5. All equipment supplied under this section shall be compatible with existing secondary equipment, if any.
6. Medical compressed air shall:

    a. Shall meet the requirements of medical air USP
    b. Shall have no detectable liquid hydrocarbons.
    c. Shall have less than 25 ppm gaseous hydrocarbons
    d. Shall have equal to or less than 1 mg/m3 (6.85 × 10-7 lb/yd3) of permanent particulates sized 1 micron or larger in the air at normal atmospheric pressure.
    e. Shall have a maximum dew point that is below the frost point [0°C (32°F)] at 345 kPa to 380 kPa (50 psi to 55 psi) at any level of demand.

1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for medical gas systems materials and products.

B. Shop Drawings: Submit scaled layout drawings of medical gas systems pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, equipment connections, and gas outlets. Indicate interface and spatial relationship between piping and proximate equipment.

C. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.

D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

E. Maintenance Data: Submit maintenance data and parts lists for medical gas systems materials and products. Include this data, product data, shop drawings, record drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 23.

F. Installer Qualifications: Submit installer qualifications, including brazing certifications and medical gas training documentation.

1.3 DELIVERY, STORAGE, AND HANDLING:

A. Deliver medical gas equipment, including air compressors, vacuum pumps, and gas storage units with factory-installed shipping skids; accessories packaged in factory-fabricated fiberboard containers; and pipe/tube with plastic end-cap protectors to prevent pipe-end damage and to eliminate dirt and moisture from entering interior of pipe/tube.

B. Handle medical gas piping and equipment carefully to avoid damage to components, enclosures and finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.

C. Store medical gas piping and equipment indoors and protect from weather and construction traffic.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide medical gas systems products by one of the following:

1. Medical Gas Equipment and Accessories:

a. Chemetron Medical Div.; Allied Healthcare Products, Inc.
b. BeaconMedeas
c. Amico
d. Ohio Medical
e. Hill-Rom

2. Vacuum Pumps:

a. Becker
b. Amico
c. Quincy
d. Squire Cogswell
e. Allied Health
f. Reitschle

g. BeaconMedeas
h. Powerex

3. Oil-Less Medical Air Compressors:

a. Quincy
b. Allied Healthcare Products
c. Atlas Copco
d. Beacon
e. Medeas
f. Powerex
g. Amico

2.2 MATERIALS AND PRODUCTS:

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated.

2.3 BASIC IDENTIFICATION:

A. General: Provide identification complying with Section 23 05 53 “Identification for Mechanical Systems", and NFPA 99.

2.4 BASIC PIPES AND PIPE FITTINGS:

A. Medical Gas Piping: All above and below grade pipe for vacuum and medical compressed air shall be minimum ½” (¾” for vacuum) Type K or L copper tubing (ASTM B819), hard drawn, seamless copper tubing, except that "pigtails" of not less than 3/8” OD for positive pressure gasses, ½” OD for vacuum, soft annealed tubing, not exceeding 8 inches, may be used at outlets. Pipe shall be factory prewashed, oxygen clean grade, capped and labeled by pipe supplier and delivered sealed to the job site.

B. All fittings used for connecting copper tubing shall be wrought copper brazing fittings complying with MSS SP-73, suitable for brazed connections and especially prepared by the manufacturer for oxygen service.

C. All joints in the piping shall be made with copper-phosphorus-silver brazing alloy with 15percent silver content, BcuP-5, without flux, melting range 1190-1480deg F.

2.5 BASIC PIPING SPECIALTIES:

A. General: Provide piping specialties complying with Division 23 Section 23 05 18 "Piping Specialties."

2.6 BASIC SUPPORTS AND ANCHORS:

A. General: Provide supports and anchors, complying with Section 23 05 29 "Hangers and Supports for Mechanical Piping and Equipment", in accordance with the following listing:

1. Extension split pipe clamp, copper plated, hinged or 2- bolt for pipe support from any substrate.

2.7 IN-LINE SHUTOFF VALVES:

A. Shutoff Valves: Provide medical gas (3 piece) shutoff valves, bronze-body, double seal, full flow, union ball type, with seat seals and stem seals. Design so quarter turn of lever-type valves handle is maximum travel between open and closed positions. Design for working pressure of 300 psi minimum. Provide valves with color-coded gas identification labels.

B. In line shutoff valves intended for use to isolate existing systems for piping maintenance or to extend to new piping systems are permitted. These valves shall be located in a secure area and locked open and labeled in accordance with NFPA 99 as follows:

1. Caution - (name of medical gas) Valve
2. Do Not Close Except in Emergency
3. This Valve Controls Supply to (area served)
4. Where valve is for future, downstream piping shall be closed with brazed cap.

2.8 BASIC VIBRATION CONTROL:

A. General: Provide vibration control products complying with Division 23, Section 23 05 48 "Vibration Control", in accordance with the following listing:

1. Air Compressors and Vacuum Pumps:

a. Fabricate equipment base and spring isolators.
b. Inertia base frame and spring isolators on all locations above ground level.
c. Vibration mounting pads to solid mass and per equipment manufacturer's instructions.

2.9 MEDICAL GAS EQUIPMENT AND ACCESSORIES:

A. General: Provide factory-fabricated medical gas accessories of sizes, types, ratings and capacities indicated. Where type is not indicated, provide components and equipment complying with NFPA 99, and as determined by Installer to comply with installation requirements.

B. Station Outlets

1. Wall Outlet Stations: Medical gas outlet stations shall be Chemetron, style, modular, Quick-Connect type or approved equivalent. Modular outlet stations shall be field assembled with sequences and services indicated on the plans. Centerline spacing of multiple outlets shall be 5 inches minimum.

a. Outlet station for medical gases shall have a stainless steel face plate mounted on a chrome-plated, zinc, die- cast cover plate. The cover plate assembly shall contain the quick-connect latch release mechanism, indexing pins for safety keying the gas-specific cover plate to the appropriate rough-in box, and color-coded gas service identification. The safety-keying index pins shall be permanently captured between the cover plate and latch assembly. Designs with index pins molded in plastic will not be acceptable.

b. The latch mechanism shall be designed for one-handed, single thrust mounting and one-handed fingertip release of secondary equipment. The outlet stations shall be capable of supporting common secondary equipment, including suction regulator and half-gallon collection bottle, without the use of slide brackets.
c. The cover plate shall attach to the primary valve assembly. The primary valve shall be threaded into the rough-in box separately from the cover plate to facilitate leak-testing around the valve. Designs which prevent this test will not be acceptable. The primary valve body shall be made of brass and shall be adjustable to compensate for variation in plaster thickness. Provide an O-ring within the valve to seal mating adaptor plugs. Future replacement of this O-ring shall not require disassembly of the cover plate. The primary valve poppet shall be self-sealing in service, requiring no dust cap or cover.
d. The rough-in box shall be made of corrosion resistant, zinc plated, sheet steel with provisions for field- ganging, by the installer. Provide two, factory- started, slotted, hex-head screws and fasteners with each rough-in box. Installer may gang rough-in boxes using holes provided for 1/8inch diameter pop rivets.
e. Each rough-in box shall contain a base and tube assembly consisting of a Type K copper pigtail, flared to accept ¼" ID, 3/8inch OD supply line for pressure gases, 2/8 inch ID, ½" OD for vacuum, brass block and base housing a secondary check valve per NFPA 99 (not required in vacuum), primary valve O-ring seal, check valve deflator spring (except vacuum), pressure testing cap plug, and plaster shield. The copper inlet tube shall be capable of rotating 360 degrees to adjust for field piping conditions.
f. The secondary check valve shall be fully automatic and self-sealing upon removal of the primary valve. The primary valve seal shall be field replaceable WITHOUT shutting off gas supply to the outlet station. Designs that preclude servicing the primary valve seal in this manner will not be accepted.
g. Medical gas outlets shall be cleaned for oxygen service in accordance with CGA Pamphlet G-4.1. The assembly shall be capped and internal parts poly-bagged for shipment. The outlet assembly shall bear the label of listing under Re-examination Service of Underwriter's Laboratory.
h. Before installation, refer to Installation Instructions and familiarize all personnel with proper installation techniques and safe-guards per NFPA 99.
i. Outlets shall be located as indicated on plans, 60 inches from finished floor unless otherwise indicated on the architectural drawings.
j. Provide matching slide bracket where shown on architectural drawings.

2.10 MEDICAL AIR COMPRESSOR:

A. The system shall be a complete medical air source, complying with all relevant requirements of NFPA 99 and supplying medical air continuously for the life of the equipment. All components shall be at least duplexed and valved to permit service to any component without interrupting air supply to the facility.

B. The system shall be a complete plant consisting of compressors, receiver and controls capable of providing scheduled SCFM with one compressor out of service. Dew point and CO monitors shall be prewired on a system not requiring separate power source. Dew point monitor shall be the ceramic type. Chilled mirror or aluminum oxide sensors are not acceptable.

C. System shall be completely factory assembled, requiring only interconnection between modules on site. Systems requiring site assembly other than interconnection are not acceptable (remounting of components removed for shipping is permitted). Each compressor shall have a piped intake manifold with one inline inlet air filter with isolation valve. The inlet filter housing shall be isolated from the intake manifold by a braided 304 stainless steel flex connector. The inlet filter housing shall allow vertical access for replacement of the filter cartridge, and shall

minimize dirt falling into the compressor intake during service. The compressor discharge line shall include a flex connector, safety relief valve, isolation valve and check valve.

D. The control system shall be NEMA 12 and UL labeled. This control system shall provide automatic lead/lag sequencing with circuit breaker disconnects for each compressor, full voltage motor starters with overload protection, redundant 120 volt control circuit transformers, phase reversal protection, visual and audible reserve unit alarm with isolated contacts for remote alarm. HOA lighted selector switches, pressure gauge, and runtime meters for each pump. The motors shall be a NEMA rated, open dripproof unit with 1 .15 service factor suitable for 208 or 230/460 volt. All electrical disconnects shall be internal to the main control cabinet and protected by the safety interlock of that cabinet. Pumps shall not run in hand mode if pressure on receiver has been satisfied. Visual and audible alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm shall be included. A temperature sensor shall be provided at the outlet of each compressor heat to provide hi-temp alarm and shutdown that compressor. Dryers shall be controlled from main control panel with selector switches mounted on control panel.

E. Each desiccant dryer must be individually sized for peak calculate demand of the entire package, plus two more future compressors, and capable of producing a 10 degree F (-12 degree C) pressure dew point. Dryer purge flow shall be minimized through an integral demand based purge saving control system that shall include a transfer valve utilizing two ceramic slide plates that is covered by a 10-factory warranty. Units utilizing multiple solenoids or diaphragm type switching are not acceptable. Refrigerated dryers are not acceptable. The inlet to each dryer shall include a mounted prefilter rated for 0.01 micron with automatic drain and element change indicator. Fully duplexed final line filters rated for 0.01 micron with element change indicators and duplexed final line regulators and duplexed safety relief valves shall be factory mounted and piped.

F. All moving parts (fans, pulleys and belts) shall be fully protected by an OSHA approved enclosure. All support structures shall be a minimum of 10 gauge steel. The compressor modules and motors shall be fully isolated from the main compressor base by means of a four point, heavy-duty isolation system for a minimum of 95 percent isolation efficiency. Engineering data shall be provided supporting efficiency and equal weight distribution between supports.

G. System piping shall be brazed except where unions are required. Systems using rubber flex connectors with hose clamps are not allowed. The air receiver shall be corrosion resistant, ASME Coded, National Board Certified, rated for a minimum 150 psig design pressure and include a liquid level glass, safety relief valve, manual drain valve, and a screened automatic solenoid valve. During normal operation the flow of air will travel through the tank to allow water to condense in tank. The complete package shall be prewired, pre-piped and assembled on one common base with single point connections for electrical, intake air, discharge air, and condensate drains.

H. The compressors shall be an oil-less scroll type as follows:

1. The compressors shall be continuous duty rated with sealed bearings. The design shall be single stage, air-cooled, consisting of one fixed and one orbiting scroll sealed with PTFE tip seals between the scroll halves and rated for 120 psig discharge pressure.
2. Heat dissipation shall be achieved through an integral cooling fan and air ducting. The compressors shall be v-belt drive with an OSHA approved belt guard, and a sliding motor mounting base.
3. The motor shall be a NEMA rated, open drip proof, 3600 RPM, with 1.15 service factor suitable for 208 or 230/480V electrical services.
4. Each compressor shall have a temperature shutdown switch.
5. The compressor module discharge line shall include a flex connector, safety relief valve, isolation valve and an integral valve to provide load-less starting.

6. The discharge flex connector shall be braided 304 stainless steel, brass or bronze.

I. Air Receiver:

1. The vertical air receiver shall be corrosion resistant, ASME Coded, National Board Certified, rated for a minimum 150 psig design pressure and include a liquid level gauge glass, safety relief valve, manual drain and timed automatic solenoid drain valve.

J. Dew Point Hygrometer/CO Monitor:

1. The package shall incorporate a dew point hygrometer and CO monitor that are both pre-wired to include remote alarm contacts, as well as pre-piped. The digital dew point display shall be mounted in the main control panel. The dew point sensor shall be the ceramic type (aluminum oxide type is not acceptable) with system accuracy of ± degree F.
2. The CO sensor shall be a chemical type with system accuracy of ± 2PPM (at 10PPM) for carbon monoxide. The dew point alarm shall be factory set at 4 degree C (39 degree F) per NFPA 99, and the CO alarm shall be factory set at 10PPM. Both set points shall be field adjustable.
3. High CO and high dew point conditions shall be indicated with visual and audible alarms.

K. Additional Components:

1. Local Alarm Panel Indicating:

a. Dewpoint
b. Back-up compressor operating
c. High water level in receiver
d. High water level in separator
e. High discharge air temperature
f. High carbon monoxide levels

2.11 VACUUM PUMP:

A. Vacuum pump shall be an modular vacuum system consisting of two vacuum pumps mounted on a common skid with expandable automatic alternating electrical controls and a horizontal receiver.

B. Each vacuum pump shall be a lubricated rotary vane type.

C. Each vacuum pump shall be direct-drive by a TEFC electric motor. Actual brake horsepower shall not exceed the rated horsepower at any time from open flow (0 vacuum) to ultimate vacuum (no flow). Belt drives shall not be permitted. Each pump shall be air-cooled and have absolutely no water requirements. Auxiliary heat exchangers shall not be permitted.

D. Lubrication shall be provided by an integral, fully recirculating oil supply driven by differential pressure. Oil pumps, either direct or separately drive, shall not be permitted. Non-recirculating (once-through) or partial recirculating oil supply systems shall not be permitted. Each pump shall be equipped with an oil drain valve. Each pump shall be capable of operation with standard SAE 30 weight automotive grade oil. The separation system shall be capable of removing 99.9+ percent of all oil and smoke particles from the exhaust gas stream.

E. Each pump shall have a built-in non-return valve mounted at the pump inlet, and each pump shall be equipped with three non-metallic, non-asbestos vanes, each having a minimum life of 30,000 hours. Each pump shall be equipped with a 5-micron inlet filter.

F. All pumps shall be skid mounted in a vertical arrangement. Pumps shall be connected to a common manifold and piped to an ASME coded vertical receiver. The receiver shall be equipped with a three-valve bypass arranged to permit draining and servicing the receiver without interruption of the vacuum system operation. The manifold shall include pre-installed ball-type isolation valves for all present and future pumps. Each vacuum pump shall be equipped with a check valve, a liquid filled vacuum gauge at the inlet of the pump a flex connector, and a bleed valve to permit venting of the inlet filter.

G. Electrical controls shall be of the automatic alternating, lead/lag cascading type and shall consist of the following: (3) magnetic motor starters, each complete with a motor branch-circuit disconnect,, and thermal, magnetic, and short-circuit protection; redundant, low voltage control transformers with fused primary and secondary; (3) digital hour meters with battery backup and remote indication; (3) hand-off-auto switches with pump run lights and remote indication when the switch is not in “auto”; pressure transducer to monitor and control the system operating vacuum level, with digital readout mounted on the enclosure door and remote indication; programmable controller with plug-in EEPROM module; reserve-pump-in-use alarm with red warning light, silencable 95dBA audible signal, and two additional sets of dry contacts for remote signaling; emergency shut-off switch; all housed in a NEMA 12 enclosure. The motor starters shall be mounted on a buss-bar type DIN rail for easy future expansion. The entire motor control center shall be configured for future expansion to an automatic alternating pentaplex or seuplex unit with the addition of only one hour meter, one H-O-A switch and one motor starter for each pump. No additional vacuum switches and no new EEPROM shall be required when expanding.

H. This control center shall alternate on a first-on, first-off basis, ensuring that no pump turns on and off successively without all other pumps in the system running first, and on a timed basis to ensure approximately equal run time for each pump. A time delay relay shall control all motors to ensure that no pump exceeds the NEMA recommended number of starts and stops per hour. All pumps will be set to turn on in a cascading (lead-lag) sequence, and will shut off when the vacuum level reaches the high set point, providing the time delay has elapsed. In the case of a power failure, the program shall be automatically downloaded from the EEPROM and the system shall restart automatically.

I. The vacuum system shall meet all requirements of the NFPA 99-1996 Standard for Health Care Facilities. The entire system shall be factory assembled by the vacuum pump manufacturer. The entire system shall be tested to insure that all performance specifications are met. Certified test data will be furnished at no charge.

J. The control center shall be capable of communicating to the building automation system (BAS) through either an open protocol (Modbus, Conworks, Johnson Controls Metasys – coordinate with section 23 09 23), or through hardwired points. At a minimum the following information shall be made available:

1. Each motor status
2. Each H-O-A “not in auto”
3. Vacuum level
4. Each motor run time
5. Reserve in use
6. System fault

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which medical gas systems and equipment are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION:

A. Install medical gas piping signs on piping in accordance with NFPA 99 requirements.

3.3 INSTALLATION OF MEDICAL GAS PIPING:

A. The Contractor shall furnish all labor, materials, equipment and services necessary to install a complete distribution system for medical compressed air and vacuum and to perform all required "progresses" and final tests.

B. The entire medical gas system, or major sections of large systems, shall be completely installed and pressure tested prior to concealing within walls, ceiling or chases.

C. The Contractor shall be responsible for furnishing and installing all material and equipment listed in this specification and shown on the construction drawings, including piping, pipe fittings, pipe connectors and all related accessories.

D. The Contractor shall be responsible for final testing of all special piping systems as required by this specification and those required to comply with all local and state health and hospital codes and ordinances.

E. Medical gas materials and tools shall be kept separate from all other materials and tools.

F. Piping shall not be cleaned in the field, except where pipe ends have become contaminated. If required, wash in hot solution of sodium carbonate or trisodium phosphate mixed in proportion of 1-lb. to 3 gal. of water.

G. Scrubbing shall be employed where necessary to ensure complete cleaning. After washing, the material shall be rinsed thoroughly in clean hot water. After cleaning, particular care shall be exercised in the storage and handling of all pipe and fittings. Pipe and fittings shall be temporarily capped or plugged to prevent recontamination before final assembly. Tools used in cutting or reaming shall be kept free from oil and grease. Where such contamination has occurred, the items affected shall be rewashed and rinsed. Do not use steel wool to mechanically clean fittings or tubing. Wipe joints with a clean white cloth prior to joining piping. During brazing of medical gas systems the piping shall be continuously purged with dry nitrogen to avoid oxidation of the inside of the tubing. Braze piping within one hour of being mechanically cleaned.

1. The use of organic solvent, for example, carbon tetrachloride, is prohibited.

H. Braze piping joints and connections unless otherwise indicated. Do not use flux.

I. Protect buried gas piping against freezing and corrosion with underground piping insulation and corrosion-protective coating. Underground piping shall be installed in a continuous enclosure.

The enclosure to be split or otherwise to provide access to joints for testing. Piping shall be below frost line or minimum 36 inch bury. Provide continuous tape marker immediately above buried pipe.

J. After installation of piping, but prior to installation of outlet valves, blow lines clear with Grade "D" oil-free dry air or nitrogen.

K. Exhaust piping from duplex vacuum pumps shall be combined into 3-inch pipe header with sound dampening muffler and 3-inch exhaust pipe extending either through the roof or terminating through the wall at least ten (10) feet from any door, window or other opening in the building and at least 20 feet above the ground. Provide end of exhaust pipe with bird screen and end turned down or with rain cap. Pipe header shall have 10inch long drip leg with valve and drain pipe to indirect connection at floor drain.

L. Medical gas piping systems shall not be used as a grounding electrode.

M. The air intake to Medical Air Compressors shall be located outdoors above roof level a minimum distance of 10 feet from any door, window, intake, or opening in the building; a minimum distance of 20 feet above the ground; and a minimum distance of 25 feet from exhaust outlets of ventilating systems, combustion equipment stacks, medical-surgical vacuum systems, plumbing vent stacks, or from areas which may collect vehicular exhaust or other noxious fumes.

3.4 INSTALLATION OF SUPPORTS AND ANCHORS:

A. Install supports and anchors, in accordance with Division 23, Section 23 05 29, "Supports and Anchors".

3.5 INSTALLATION OF VALVES:

A. Shutoff Valves: Provide shutoff valves where indicated.

B. Main Shutoff Valves: Where indicated, provide shutoff valve down stream of source valve on each main supply line, locate to be accessible in emergency.

3.6 INSTALLATION OF EQUIPMENT AND ACCESSORIES:

A. Install medical gas equipment and accessories where indicated, in accordance with applicable NFPA standards, with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that medical gas equipment and accessories comply with requirements and serve intended purposes.

B. Coordinate with other work including plumbing, as necessary to interface installation of medical gas piping and equipment with other work.

C. Air Compressor Intakes: Install air compressor intakes and vacuum pump exhausts as indicated, and in manner to ensure that vacuum pump exhaust will not contaminate air compressor intake nor HVAC ventilation system.

D. Support: Install equipment on 4inches high reinforced concrete pads, 4inches larger on each side than equipment base. Cast anchor bolt inserts into pad.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Provide and install all power wiring for equipment and alarm panels and all signal wiring between equipment or sensors or transducers and the alarm panels. Wiring methods shall be in accordance with applicable provisions of Division 26.
2. Provide and install contacts, interfaces, and gateways as required to communicate with the Building Automation System as specified or shown on the drawings.
3. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Ceiling dispensing boxes and reels and ceiling mounted service columns shall be provided by the Mechanical Contractor and installed by the General Contractor. Mechanical Contractor shall make all medical gas and vacuum piping connections. Electrical Contractor shall install all wiring and make electrical connections.

3.7 EQUIPMENT CONNECTIONS:

A. General: Connect medical gas systems to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.8 FIELD QUALITY CONTROL:

A. Test medical gas piping, including pressure, cross connection, and final testing in accordance with NFPA 99. Indicate in writing to Owner that required tests have been successfully conducted and permanent records of tests maintained.

3.9 TESTS FOR MEDICAL GAS PIPING:

A. Pressure test in strict accordance with NFPA 99 will be required. Specific attention is directed to absolute prohibition of the use of oil pumped compressed air or oil pumped nitrogen and the prohibition of the use of hydrostatic test. Testing medium shall be WATER PUMPED COMPRESSED AIR or VAPOR PUMPED NITROGEN. Cylinder shall be so labeled.

B. A 24-hour standing pressure test with oil free (water pumped) nitrogen or air at one and one-half times maximum working pressure, but in no case less than 150 psi., shall be made prior to "trimming" medical gas outlet station valves to check the completeness of previous joint tests. After trimming out the medical gas outlet stations, the system shall be tested for 24 hours at 20 percent above working pressure. After completion of the final standing pressure test, the system shall be thoroughly flushed with the gas to be used in the system to assure the removal of all nitrogen or air.

C. After completion of final testing and flushing of the piping system, the medical gas system shall be tested in accordance with NFPA 99 by the medical gas equipment supplier, in the presence of an authorized representative of the Owner. The medical gas equipment supplier shall furnish written certification to the Owner that the system has been so tested and is free of crossed-connections. Cost of gases required for testing shall be borne by the Mechanical Contractor. Further, the cost of subsequent tests required to re-check initial errors shall be the responsibility of this contractor.

D. When all medical gas piping systems have been tested as specified above, the source of test gas shall be disconnected and the proper gas source of supply connect as specified above, the source of test gas shall be disconnected and the proper gas source of supply connected to each respective system. Following this connection and pressurization, all outlets shall be opened in a progressive order, starting nearest the source and completing the process of purge flushing at the outlet farthest from the source. Gas shall be permitted to flow from each outlet until each system is purged of test gas used during previous tests.

3.10 MEDICAL GAS SYSTEMS VERIFICATION & CERTIFICATION:

A. General: Evaluate and certify medical gas systems, including source equipment, valving, alarms, and station outlets, for mechanical and therapeutic function.

1. Provide certification by Agency independent of facility, system Installer, Contractor, and Suppliers.
2. Mechanical and Therapeutic Function: As defined in NFPA 99 and CGA P2.1.

B. Provide full documentation of the following:

1. That no cross connections exist in pipeline as constructed.
2. Include in documentation, examination of outflow of each station outlet, following mechanical cross connection procedure as specified by NFPA 99, Additionally, examine each system outflow with appropriate analyzer and document concentrations. Include Medical Gas and Vacuum systems in mechanical examination.
3. Where laboratory systems are treated as separate systems, perform cross connection tests to document their separation from medical systems as required by NFPA 99.
4. That station outlets are delivering gas at pressure and flow consistent with needs indicated, but in no case to be below CGA or NFPA guidelines.
5. That pipeline is free of debris, including liquid.
6. That station outlets are functional.
7. That delivered gas is as pure as required by applicable CGA specifications for breathing gas. Take samples from such station outlets as agreed by facility and agency. In no case shall number of samplings be fewer than two, one from source and one from such station outlets as will provide gas has traversed greatest length of pipeline. Evaluate samples against CGA requirements for human use and compare to one another.
8. That reserve source equipment and its control equipment is in place and is operational.
9. That valves are functional. Document control zones without regard to plans. Compare this documentation to as-built plans, and report discrepancies between actual installation and plans to facility.
10. That alarms are functioning and are set in accordance with NFPA 99. Document and compare surveillance areas of each to record drawings, and report discrepancies between actual installation and drawings to Architect/Engineer.
11. That medical air is dry. Examination shall consist of dewpoint taken at source and most distant station outlet of each lateral branch. Document temperatures and pressures affecting dryness.

END OF SECTION 226000

SECTION 230500- COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.

C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY:

A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.3 MECHANICAL INSTALLATIONS:

A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.

D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not

intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.

G. Verify all dimensions by field measurements.

H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.

I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

K. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.

M. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset and system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

N. In general, all “static” piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all mechanical equipment, opening/closing of all valves, draining/refilling all mechanical systems and operating/verifying the operation of all mechanical systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.4 COORDINATION:

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21 and 23 Contractors.
2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.
3. Furnish building equipment (elevator, food service, medical, technology, etc) in formation to Div 21, 22, and 23 contractors.

C. Coordination Drawings:

1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.
2. Submit drawings for all areas, pay special attention to those places where clearances are limited, where space problems exist, for places where several elements of work (or combinations of mechanical and other work) must be located with precision in order to fit into available space, where sequencing is of importance to the efficient flow of work and as specified, and required.
3. Coordination drawings are informational submittals. Submit coordination drawings to Engineer for information only to document proper coordination of all portions of work and that coordination issues have been identified and resolved prior to submitting to the Engineer and prior to commencing construction in each affected area. The review of the coordination drawings by the Engineer does not constitute a relief of responsibility of the Contractor or a change to the contract documents. The Contractor shall have sole responsibility in developing a fully coordinated and integrated ceiling cavity.
4. The Contractor shall take the lead in coordinating and drawing Division 26 and other Division 21, 22, and 23 components such as fire protection, plumbing, piping, sheet metal, etc. Where appropriate, the Contractor shall include medical gas, conduit, cable trays, pneumatic tube and any other system which may occupy the ceiling cavity.
5. Clearly indicate solutions to space problems. Identification of space problems without solutions is not acceptable. Only areas clearly identified will be reviewed.
6. All coordination drawings shall be 3D, with provision for collision check. The contractor is responsible for obtaining the architectural and structural files in 3D, if not available, the contractor shall develop them from the 2D architectural and structural drawings. All 3D drawing development, collision check, coordination, etc. shall be included as part of the Contractors base bid.
7. Prepare Coordination Drawings and other Shop Drawings at a suitable scale, showing the required dimensions. In addition to the mentioned areas and systems above, also submit the following:

    a. All mechanical equipment rooms such as fan rooms, boiler rooms, fire protection system rooms, etc. (1/4”=1’-0” scale).
    b. All building floor plans (1/8”=1’-0” scale). Include all shafts with clearances.
    c. Air handling unit, etc. main duct connections and transitions in ceiling space and to shafts or horizontal ducts. (1/4”=1’-0”).
    d. Required access for all equipment requiring code or maintenance access.
    e. All sections and elevations necessary for clarification.
    f. Indicate all seismic restraint and support systems to be used for all mechanical equipment throughout the project.
    g. Indicate duct and pipe elevations. Indicate clearances for installing and maintaining insulation.
    h. Servicing and maintaining equipment, valve stem movement, and similar requirements.
    i. Indicate movement and positioning of large equipment into the building during construction. Indicate pipe and duct size. Indicate equipment tags.

8. CADD Drawings: Electronic mechanical AutoCAD drawings are available for purchase by the Contractor from the Engineer. Contact Engineer for further information in acquiring CADD drawings. The Engineers Construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.

D. Existing Conditions:

1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing 3D drawing.
2. Contractor shall be responsible for showing all existing conditions on the 3D coordination drawings.
3. Provide proper coordination of mechanical work with existing conditions.
4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Pneumatic tube systems.
4. Ductwork mains
5. Plumbing vent piping
6. Medgas/lab gas systems
7. Low pressure ductwork and air devices.
8. Electrical and communication conduits, raceways and cabletray.
9. Domestic hot and cold water
10. Hydronic piping
11. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
12. DDC control wiring and other low voltage systems.
13. Fire alarm systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete basis and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.

G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR:

A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
2. Any system not fully detailed
3. Fire protection systems
4. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
5. Temperature controls systems
6. Refrigeration systems
7. Seismic restraint systems

D. Design Limitations:

1. The Contractor shall not modify the Engineers design intent in any way.
2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
3. The Contractor shall conform to the SMACNA Duct Construction Standards when modifying the ductwork layout to avoid collisions.
4. Back to back 90° fittings on duct system shall not be installed under any circumstance.
5. Bull nosed tees on piping systems shall not be installed under any circumstance.

1.7 PROJECT CONDITIONS:

A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

B. Field verify all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.

G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.

H. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.

I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.8 SAFETY:

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

A. Refer to Division 1.

B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.

C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies.

D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

E. The handling, removal and disposal of regulated refrigerants and other materials shall be in accordance with U.S. EPA, state and local regulations.

F. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.

G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.11 REQUIREMENTS OF LOCAL UTILITY COMPANIES:

A. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required but not provided by Local Utility Company for the project.

B. Utility Connections:

1. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
2. The contract documents indicate the available information on existing utilities and services and on new services (if any) to be provided to the project by utility companies and agencies. Notify Engineer immediately if discrepancies are found.
3. Coordinate mechanical utility interruptions one week in advance with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

1.12 PERMITS AND FEES:

A. Refer to Division 1.

B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.13 PROJECT SEISMIC REQUIREMENTS:

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

B. All systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.14 TEMPORARY FACILITIES:

A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.

B. Use of Permanent Building Equipment for Temporary Heating or Cooling: Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's

instructions and protected with filters, strainers, controls, reliefs, etc. Steam and hydronic systems shall be flushed and chemically treated. Ductwork and air moving equipment shall be cleaned to an “AS New” condition. All filters required for the construction period shall be equivalent to the filters required for the final installation. All filters shall be replaced at the time of substantial completion. The guarantee period of all equipment used shall not start until the equipment is turned over to the Owner for his use. A written record of maintenance, operation and servicing shall be turned over to the owner prior to final acceptance.

1.15 PRODUCT OPTIONS AND SUBSTITUTIONS:

A. Refer to the Instructions to Bidders and Division 1.

B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.

1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.

1.16 MECHANICAL SUBMITTALS:

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:

a. Product
b. Plan Code (if applicable)
c. Specification Section
d. Manufacturer and Model Number

7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards.

D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.

E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21, 22, and 23 Sections.

F. The Design Professional’s review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

G. The Design Professional’s review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional’s judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the

Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

K. The contractor shall cloud all changes made on submittals that are marked “Revise and Resubmit.”

L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.17 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

A. Product Listing:

1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.

    a. Provide all information requested.
    b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."

2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
3. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.

    a. Provide products which are compatible within systems and other connected items.

B. Schedule of Values

1. Provide preliminary schedule of values with product data submittal, within three (3) weeks from award of contract to successful bidder. Provide according to the following descriptions:

    a. Plumbing
    b. Fire Protection
    c. HVAC
        1) Equipment
        2) Sheet Metal
        3) Piping
        4) Insulation
        5) Test and Balancing

6) Specialty Systems
7) Temperature Controls

d. Demolition
e. Miscellaneous

2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

a. Sizes.
b. Weights.
c. Speeds.
d. Capacities.
e. Piping and electrical connection sizes and locations.
f. Statements of compliance with the required standards and regulations.
g. Performance data.
h. Manufacturer's specifications.

D. Shop Drawings:

1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8”-1'-0", unless otherwise noted.

a. Show clearance dimensions at critical locations.
b. Show dimensions of spaces required for operation and maintenance.
c. Show interfaces with other work, including structural support.

E. Coordination Drawings: See separate paragraph of this specification section.

F. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

G. Operation and Maintenance Data: See separate paragraph of this specification section.

H. Software Licenses: Provide documentation of ownership under the owner’s corporate name (coordinate with owner’s representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription

requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

I. Record Drawings: See separate paragraph of this specification section.

1.18 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.

E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

F. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.

G. Protect stored ductwork, pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.

I. Protect sheet metal ductwork and fittings. Elevate and store above grade and cover ends with waterproof wrapping.

1.19 DEMOLITION:

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping or ductwork and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.

1. Return existing thermostats and humidistats to the owner.
2. Return all demolished control valves and devices to the Owner.
3. Return existing plumbing fixtures to the Owner.
4. Return existing medical gas outlets to the Owner.

5. Return existing unused/not relocated ceiling diffusers to the Owner.

C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

D. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.

1.20 CUTTING AND PATCHING:

A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

B. Refer to Division 1.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.

F. Perform cutting, fitting and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work;
2. Remove and replace defective work;
3. Remove and replace work not conforming to requirements of the Contract Documents;
4. Remove samples of installed work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.

G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim and other mechanical items made obsolete by the new work.

H. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.

J. Locate, identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner

prior to changeover. Cover openings in ductwork to remain. Protect equipment and systems to remain.

1.21 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

C. Work through all coordination before rough-in begins.

1.22 ACCESSIBILITY:

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

C. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and Division 23 for duct access door requirements.

D. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

E. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

F. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

G. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.

H. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, sensors, motors, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.23 BELTS, SHEAVES, IMPELLERS:

A. The Mechanical Contractor shall coordinate with the Test and Balance Contractor and supply correctly-sized drive belts, sheaves, and trimmed impellers.

1.24 EXCAVATING AND BACKFILLING:

A. General:

1. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring." Follow specifications of Division 23 as they refer specifically to the mechanical work.

B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.

C. Pipe Trenching:

1. Provide all necessary pumping, cribbing and shoring.
2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.
3. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.

D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

1. Provide warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.

a. Tape shall have magnetic strip and be used for exterior underground system only.

E. Trench Backfill:

1. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.

F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.

G. This contractor shall repair and pay for any damage to finished surfaces.

H. Complete the backfilling near manholes using pea gravel or squeegee, installing it in 6 inch lifts and mechanically tamping to achieve 95 percent compaction.

I. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

1.25 NAMEPLATE DATA:

A. Provide permanent operational data nameplate, refer to the section on Mechanical Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1.26 LUBRICATION OF EQUIPMENT:

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Contractor shall properly lubricate all mechanical pieces of equipment which he provided before turning the building over to the Owner. He shall attach a linen tag or heavy duty shipping tag on the piece of equipment showing the date of lubrication and the type and brand of lubricant used.

C. Furnish the Engineer with a typewritten list included in the O&M manuals of each item lubricated and type of lubricant used, no later than two (2) weeks before completion of the project, or at time of acceptance by the Owner of a portion of the building and the mechanical systems involved.

1.27 CLEANING:

A. Refer to Division 1.

B. Refer to Division 23, "TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

1.28 RECORD DOCUMENTS:

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping or ductwork relocated more than 1foot-0inches from where shown on the drawings.

D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.

F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:

1. Red shall indicate new items, deviations and routing.
2. Green shall indicate items removed or deleted.
3. Blue shall be used for relevant notes and descriptions.

G. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

I. At the completion of the project, obtain from the Architect a complete set of the Mechanical Construction Documents in the electronic format used by the design team. This set will include all revisions officially issued through the Architect. The Contractor shall transfer all revisions noted on the record document prints to the electronic drawings. The Contractor shall transmit the final record documents in the electronic format used on the project to the Architect. This contract will not be considered completed until these record drawings have been received and reviewed by the Architect/Engineer.

1.29 OPERATION AND MAINTENANCE DATA:

A. Refer to Division 1.

B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).

C. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.

D. In addition to the information required by Division 1 for Maintenance Data, include the following information:

1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
2. Description of mechanical equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

3. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
5. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
6. Manufacturer's service manuals for all mechanical equipment provided under this contract.
7. Include the valve tag list.
8. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
9. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
10. Complete recommended spare parts list.
11. Mechanical System and Equipment Warranties.
12. Copies of all test reports shall be included in the manuals.
13. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
14. Final schedule of values with all mechanical change order costs included and identified.
15. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.

1.30 PROJECT CLOSEOUT LIST:

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

B. The Contractor shall be responsible for the following Mechanical Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.31 WARRANTIES:

A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 21, 22, and 23, into the Operating and Maintenance Manuals.

C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.32 CONSTRUCTION REQUIREMENTS:

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1. Up to date record drawings.
2. Submittals
3. Site observation reports with current status of all action items.
4. Test results; including recorded values, procedures, and other findings.
5. Outage information.

1.33 EQUIPMENT HOUSEKEEPING PADS:

A. Provide 4" concrete housekeeping pad for all floor mounted equipment including, but not limited to: air compressors, air handling units, boilers, chillers, condensing units, cooling towers, deaerators, fans, furnaces, medical gas equipment, processed water systems pumps, storage tanks, water heaters, and water treatment systems. Fabricate pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 4" larger in both directions than the overall dimensions of the supported unit.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
3. Place concrete and allow to cure before installation of units. Use Portland cement that conforms to ASTM C 150, 4000-psi compressive strength, and normal weight aggregate.
4. Anchor housekeeping pads to slab using #3 rebar bent in “L” or “Z” shape 12 inch on center on each side of slab.

1.34 MECHANICAL SUBMITTAL CHECKLIST:

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req’d At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
210500	Common Work Results For Fire Suppression	X	X	X	X	X		X	X
211000	Water Based Fire Protection	X	X	X	X	X		X	X
220500	Common Work Results For Plumbing			X					
221110	Facility Water Distribution Piping		X	X	X	X			X
221319	Sanitary Waste Piping Specialties		X	X	X	X			
224000	Plumbing Fixtures		X	X					X
230500	Preliminary Schedule Of Values					X			
230500	Final Schedule Of Values			X		X			
230500	Equipment Warranties			X					
230500	O&M Manuals		X	X		X			X

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test[3]	Report[3]			
230500	Coordination Drawings	X							
230500	Record Drawings	X	X	X					
230507	Motors, Drives, Motor Controllers	X	X	X					
230509	Mechanical Fire Stopping	X	X	X				X	
230510	Basic Piping Materials And Methods		X	X	X	X			
230518	Piping Specialties		X	X					
230519	Meters and Gauges		X	X		X[2]			X
230523	Valves		X	X					
230529	Hangers and Supports	X	X	X					
230540	Vibration Control	X	X	X	X	X			
230553	Mechanical Identification		X	X					X
230593	Testing ,Adjusting and Balancing	X		X	X	X			
230700	Mechanical Insulation		X	X					
230900	Instrumentation and Control for Mechanical	X	X	X		X	X	X	
230993	Sequence Of Operation			X					
233113	Metal Ducts	X	X	X	X	X			
233300	Air Duct Accessories		X	X		X			X
233600	Air Terminals Units		X	X					
233713	Diffusers, Registers & Grilles		X	X					X

Notes:
[1] For Starters and Variable Frequency Drives
[2] Requires Review & Approval of calibrated balance valves from T & B Contractor
[3] See Specific Specification Section for Test & Certification Requirements

END OF SECTION 230500

SECTION 230507 - MOTOR, DRIVES, MOTOR CONTROLLERS AND ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This section specifies the basic requirements for electrical components which are either separate components or are an integral part of all mechanical equipment. These components include, but are not limited to starters, variable frequency drives and disconnect switches.

B. Wiring of field-mounted switches and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.

C. Refer to electrical drawings and specifications for specific electrical requirements pertaining to mechanical equipment are scheduled on the Electrical Drawings. In case of conflict, Electrical Drawings shall take precedence. Do not purchase motors or electrical equipment until power characteristics available at building site location have been confirmed by Contractor. Provide equipment that meets all of the electrical requirements including but not limited to:

1. Voltage and number of phases
2. Circuit Ampacity,
3. Maximum Overcurrent protection
4. Short Circuit Current Rating.
5. Wire size listed. Provide lugs with the ability to terminate the provided wire size at each piece of equipment.

As a minimum provide nameplate with the above information for each piece of equipment.

D. SCCR at incoming terminals and throughout the equipment shall be rated for the available fault current at the equipment as indicated and/or required. In addition to meeting NEC requirements, including 450.52 and 450.53, provide one of the following two options based on the equipment configuration:

1. Provide individual fused disconnects rated for the available short circuit current at the disconnect with current limiting fuses supplying mechanical equipment and packaged equipment (for example; a single piece of equipment or starter, a packaged piece of equipment such as a rooftop unit, etc.). See Division 26 requirements for disconnects, fuses, available short circuit values, etc. SCCR of the equipment can be rated for the let thru of the fuse WHEN the equipment does not have a main or other circuit breaker that provides additional levels of branch circuit/short circuit protection AND if acceptable to the authority having jurisdiction.
2. Provide fully rated devices with the appropriate interrupting rating above the available fault current levels for circuits feeding equipment that contain an overcurrent device such as a main or other circuit breakers that provide additional levels of branch circuit or short circuit protection (for example: circuit breakers provided for multiple motors, VFD’s, etc. The nameplate on this type of equipment shall indicate an SCCR above the available fault level at the equipment.
3. Equipment protection schemes shall be submitted with equipment cutsheets/shop drawings.

E. Refer to Table in Division 26 for Mechanical/Electrical coordination.

F. See other sections of Division 23 for vibration and seismic control requirements.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of motors, motor starters and drives of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Single Manufacturer: Provide all motors, starters and VFDs for the project by a single manufacturer except when part of factory packaged equipment. All variable frequency drives and starters for the project shall be by a single manufacturer, including packaged equipment, except chillers, etc.

C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects utilizing motors, motor starters, capacitors and drives similar to that required for this project.

D. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of motors, motor starters, capacitors and drives.

E. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplaces".

F. UL Compliance: Comply with applicable requirements of UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors", and UL 508, "Electrical Industrial Control Equipment" pertaining to installation of motor starters.

G. UL Compliance: Provide equipment and components which are UL-listed and labeled.

H. ETL Compliance: Provide equipment and components which are ETL-listed and labeled.

I. IEEE Compliance: Comply with applicable requirements of IEEE including Std 241, "Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to motor starters and Std 519.

J. NEMA Compliance: Comply with applicable requirements of NEMA including Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies", and Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", pertaining to motor controllers/starters and enclosures.

K. In addition comply with the following standards:

1. NEMA Standards MG 1: Motors and Generators.
2. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.
3. NEMA Standard 250: Enclosures for Electrical Equipment.
4. NEMA Standard KS 1: Enclosed Switches.

L. Comply with National Electrical Code (NFPA 70).

M. Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections.

Comply with applicable requirements of Division 26 sections for electrical work of this section which are not otherwise specified.

1.3 SUBMITTALS:

A. Product Data: Submit in accordance with Section 23 05 00 “Common Work Results for Mechanical”.

B. Shop Drawings: Submit dimensional drawings of VFD’s and starters showing accurately scaled equipment layouts. Drawings shall include, as a minimum: physical dimensions of each unit; general arrangements with incoming and outgoing conduit locations, schematic; connection diagram sufficient to install system, and enclosure details.

C. Wiring Diagrams: Submit schematic power and control wiring diagrams, prepared for this project, of complete VFD and starter assemblies. General wiring diagrams with various non-applicable options shown are not acceptable. Clearly differentiate between factory and field wiring.

D. Listing, Motors of Mechanical Work: Concurrently, with submittal of mechanical products listing, submit separate listing showing rating, power characteristics, efficiencies, power factors, application and general location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.

1. Include in listing of motors, notations of whether motor starter is furnished or installed integrally with equipment containing motor or separately from equipment.

E. Electrical coordination listing. Provide the following information for each field wired electrical power connection. Information shall use nameplate data and nomenclature of actual installed nameplates. Information should list as a minimum:

1. Field connection details such as maximum/minimum wire size lugs can accommodate. Include number of lugs per phase.
2. Number and location of field connections.
3. Field interconnection wiring.
4. Nameplate Information, as a minimum include:

    a. Operating voltage and phase.
    b. Maximum fuse size (MFS) or maximum overcurrent protection size (MOP)(as applies).
    c. Minimum circuit ampacity (MCA).
    d. Full load amperes (FLA).
    e. Short Circuit Current Rating (SCCR).

5. Locked rotor current (LRA) and duration for high inertia equipment.
6. Manufacturers recommended overload setting (if applicable).

F. The contractor shall fully coordinate these items with all subcontractors prior to submittal.

G. Equipment provided shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings.

1.4 PRODUCT STORAGE:

A. All variable frequency drives, starters, etc. shall be protected from dirt, debris, and moisture at all times. Variable frequency drives shall be wrapped air and water tight with dust-tight and moisture proof material until factory start-up of variable frequency drives is initiated.

1. Exception: Drives may be opened only during wiring terminations by temperature control contractor and/or electrical contractors.

B. All motors not designed for exposure to water or moisture shall be protected at all times.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by one of the following manufacturers for each type of product:

1. Motors

a. Century/MagneTek
b. Baldor
c. Reliance
d. Westinghouse
e. Siemens
f. General Electric
g. Louis Allis
h. Lincoln
i. U.S. Motors
j. Square D

2. Starters

a. Cutler Hammer
b. Allen-Bradley
c. Sprecher & Schuh
d. Square D
e. Eaton
f. Siemens
g. GE
h. Greenheck (single phase starters)

2.2 MOTORS:

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads with a time limit acceptable to the motor manufacturer. Motors shall be capable of starting the driven equipment while operating at 90 percent rated terminal voltage.
2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

3. 2-speed motors shall have (1) single winding on poly- phase motors.
4. Explosion proof motors shall meet Underwriters Laboratories Standards for use in hazardous locations and National Electrical Code (NEC), Article 500, Class and Group.
5. Temperature Rating: Rated for 40 degrees C environment with maximum 80 degrees C temperature rise for continuous duty at full load (Class B Insulation). Provide Class F insulation for variable frequency drive motors.
6. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly times spaced starts per hour for manually controlled motors.
7. Service Factor: 1.15 for poly-phase motors, 1.35 for single phase motors, and 1.0 for inverter duty motors.
8. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Design "E" shall not be used.

    a. Frames: NEMA Standard No. 48 or 54; Use driven equipment manufacturer's standards to suit specific application.
    b. Bearings:
        1) Ball bearings with inner and outer shaft seals.
        2) Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
        3) Bearings shall be rated for minimum L-10 life of 40,000 hours.
        4) Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
        5) For fractional horsepower, light duty motors, sleeve type bearings are permitted.

    c. Enclosure Type:
        1) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
        2) Guarded drip-proof motors where exposed to contact by employees or building occupants.
        3) Weather protected Type I for housed outdoor use, TEPC II where not housed.

    d. Overload protection: Built-in thermal overload protection for all single phase motors and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
    e. Noise rating: "Quiet".
    f. Efficiency: All motors shall be NEMA premium efficiency motors, in accordance with Table 12-11 and Table 12-12 of NEMA MG 1-2011 and the US-DOE Premium Efficiency Motor Selection and Application Guide.
    g. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

9. Phases and Current Characteristics: Unless indicated otherwise, provide squirrel-cage induction polyphase motors for 3/4 hp and larger, and provide capacitor-start single-phase motors for 1/2 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split-phase type. Tri-voltage motors are not acceptable. Coordinate current characteristics with power specified in Division 26 sections. Do not purchase motors until power characteristics available at building site have been confirmed by contractor.
10. The Contractor shall be responsible for all additional electrical and other costs involved to accommodate any motors which differ from the scheduled horsepower sizes or correct any motor which does not meet the listed efficiency as called for in mechanical or electrical plans and specifications.
11. Motors shall be of the same manufacturer, except those that are an integral part of a factory assembled packaged unit. These motors shall likewise meet the conditions of the

specification in this section except motors which are part of a motor/compressor assembly are exempted from this requirement.

12. All motors 75 HP and larger shall be factory test certified for power factor, efficiency, and shall have a three year warranty. Factory certification of motor tests shall be provided to the Owner.
13. All equipment specified to operate with variable frequency drives shall be provided with inverter-duty motors specifically designed for variable speed operation with high efficiency at part load conditions and constructed with Class F inverter grade insulation. Inverter duty motors shall meet requirements of NEMA MG-1 Part 31.
14. All motors which will be operated by a variable frequency drive shall be warranted against any damage or defects as a result of being used with a variable frequency drive.

2.3 STARTERS, ELECTRICAL DEVICES AND WIRING:

A. Motor Starter Characteristics:

1. Coordinate with the Electrical Contractor for motor control center starters provided by Division 26.
2. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
3. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.
4. Provide two-speed starters with a High-Low selector switch wired to allow manual speed selection with the H-O-A in HAND or remote speed selection in AUTO. Provide an automatic accelerating relay/timer to assure that the motor will always start at low speed and operate at an adjustable time before switching to high speed. Also, provide an integral automatic decelerating timing relay to prevent damage to the motor and load when switching from high to low speed. High and low speed contactors shall be mechanically and electrically interlocked. Complete instructions shall be provided for adjusting the timer in the field to match the deceleration characteristics of the driven equipment.

    a. For cooling towers or other two-speed motors which are noted to have reversible operation, starters for those applications shall include the features described above for two-speed motors and include Reverse Selector Switch wired to allow manual direction In The Hand Position of the H-O-A. Starters with reverse direction shall have an integral built-in time delay to allow the motor to come to a full stop, prior to reversing for both the In the Hand and Automatic positions of the H-O-A switch.

B. Manual switches:

1. See Division 26 for electrical requirements, provide control devices as required for sequence of operation and/or equipment specifications.

C. Magnetic Starters:

1. Unless otherwise indicated, provide magnetic starters including contacts and coils for all 1-phase motors where interlock or automatic operation is indicated or required:

    a. Provide equipment with Short Circuit Current Rating (SCCR) above available fault current.

b. Adjustable motor overload. Select range so that upper limit is no more than 150 percent of the connected motor full load amps.
c. Interlocks, auxiliary contacts, and similar devices as required for coordination with control requirements of Division-23 Controls sections.
d. H-O-A selector
e. Pilot lights for “power on” and “run” status.
f. Mount starter and all appurtenances in a NEMA enclosure suitable for the environment.

2. Unless otherwise indicated, provide NEMA style, sized and rated 75 degrees C magnetic starters including contacts and coils for all 3-phase motors. In addition to the requirements listed above for 1-phase motors provide the following features:

a. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 120 volts.
b. Maintained contact H-O-A push buttons or selector switch, speed selector switch (for two speed starters), and pilot lights shall be located on the cover of the enclosure, properly arranged for single speed or multi-speed operation as indicated. H-O-A shall be suitable to provide a monitor point to the Building Automation System where required.
c. Electronic motor overload protection including thermal modeling type thermal protection, Ground fault protection, individual monitoring of motor current in each phase, and a wide FLA adjustment with selectable trip.
d. Each starter shall be provided with a minimum of (4) four sets of auxiliary contacts, (2) two normally open & (2) two normally closed.
e. All 3-phase motors shall be protected against loss of phase wired into the starter utilizing a solid state 3 phase monitor that senses each phase and is capable of automatic restart of equipment when adverse condition clears.

f. All 3-phase motors shall be provided with Over and Under voltage protection. The ability for automatic re-start of equipment shall be provided. Settings shall be 110% for overvoltage and 80-90% for under voltage unless stated otherwise on the motor data sheets
g. All 3-phase motors shall be protected against Voltage and current unbalance. Settings shall be 10-15% of FLA for current unbalance alarm with 5-10 second delay and 20-25% of FLA for current unbalance trip with 2-5 second delay unless otherwise stated on the motor data sheets,
h. HOA switch

3. Where reduced voltage starting is required, the starting method shall be part winding or closed transition auto-transformer/solid state electronic starting. Motors shall be constructed accordingly. Other methods of reduced voltage starting shall not be used unless reviewed by the Engineer prior to bid.
4. All starters used for life safety systems shall have an additional control relay to by-pass all external safeties and internal safeties except for overload protection. Coordinate with 23 09 93.
5. Ammeters, Voltmeters, and Frequency Meters: Where indicated. Panel type, 2 1/2 inch minimum size with 90 degree or 120 degree scale and plus or minus 2 percent accuracy. Current Sensors: Rated to suit application.

D. Motor connections:

1. PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors., except where plug-in electrical cords are specifically indicated.

2.4 DISCONNECT SWITCHES:

A. See Division 26 for electrical requirements, coordinate disconnect switch selection, installation, and wiring for equipment being provided.

2.5 DRIVES:

A. V-Belt Drives:

1. Capacity of V-Belt Drives at rated RPM shall be not less than 150 percent of motor nameplate horsepower rating.
2. V-Belt Drive combinations shall be limited to A, B, C and fractional horsepower belts. 3V, 5V and 8V belts and sheaves shall not be used.
3. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
4. All fixed pitch sheaves, including single groove fan sheaves, shall be of the bushed type. Fixed bore sheaves will not be acceptable for adjustable pitch sheaves.
5. Belts: Oil-resistant, non-sparking, and non-static.
6. Unit manufacturer shall provide OSHA approved belt guard with tachometer holes.
7. For equipment serving hazardous or critical systems (i.e., fume hoods, bio-hazards, life safety, etc.), all fans shall be provided with 1.5 times the number of belts normally required to meet above requirements, with a minimum of 2 belts.

2.6 EQUIPMENT FABRICATION:

A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives, arranged for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.1 TEST AND TEST DATA:

A. A factory load test shall be performed on each motor of 1000 watt input or greater to assure compliance with the energy-efficiency section of this specification.

B. Typical test data on every motor to be used on this project shall be made available upon request.

3.2 INSTALLATION:

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Deliver starters and wiring devices which have not been factory-installed on equipment unit to electrical installer for installation.

C. Install power and control connections for motors to comply with NEC and applicable provisions of Division 26 sections. Install grounding except where non-grounded isolation of motor is indicated.

3.3 INSTALLATION COORDINATION:

A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.

B. Verify windings of multi-speed or reduced voltage starters are compatible with the connected motor prior to installation.

C. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

D. It is the intent of this specification that one "General" Contractor enters an agreement with the Owner. The use and coordination of subcontractors is at the option of the General Contractor. All mechanical equipment, motors and controls shall be furnished, set in place, and wired. The schedule contained in Division 1 / 26 is provided as a guide only. The exact furnishing and installation of the equipment is left to the Contractors involved. Contractor should note that the intent of the schedule is to have the Division 23 and 26 Contractors responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

END OF SECTION 230507

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SECTION 230509- MECHANICAL FIRE STOPPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of firestopping required by this section is indicated on the drawings and by the requirements of this section.

B. Types of firestopping systems specified in this section include:

1. Bare metal pipe
2. Insulated metal pipe
3. Plastic piping
4. Metal conduit
5. Metal duct

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacturing of firestopping systems for mechanical/electrical penetrations, whose products have been in satisfactory use for not less than 5 years, with published application data for all types of penetrations to be encountered on this job, and with local representation capable of providing training and technical assistance at the job site.

B. Installer's Qualifications: Personnel installing firestopping systems shall have been specifically trained by the manufacturer in the application of the materials to comply with the listing of the tested assembly.

C. Codes and Standards: Comply with the applicable codes pertaining to firestopping. Firestopping systems shall be tested and listed in accordance with the following:

1. Underwriter's Laboratory:

a. UL 1479 test method for fire tests of through-penetration firestops.
b. UL Fire Resistance Directory

2. American Society for Testing and Materials: ASTM E814-88 standard test method for fire tests of through-penetration firestops.

1.3 SUBMITTALS:

A. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.

B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware and installation procedures, plus the following specific requirements:

1. Details of each proposed assembly, for all types of fire rated construction and penetrating items encountered, identifying intended products and applicable UL System Number, or UL classified devices.
2. Manufacture or manufacturer's representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Packing and Shipping:

1. Deliver products in original, unopened packaging with legible manufacturer's identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and Protection: Store materials in a clean, dry ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.5 PROJECT CONDITIONS:

A. Existing Conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental Requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with the requirements of this specification, provide products by one of the following:

1. Hilti Corporation

2.2 GENERAL:

A. Provide fire stop systems listed in the UL Fire Resistance Directory. Provide systems with fire resistance "F" ratings equal to the fire resistance rating of the wall or floor assembly for all penetrations. In addition, provide systems with a "T" rating equal to the fire resistance rating of the floor assembly for all floor penetrations not within the cavity of a wall.

2.3 ACCESSORIES:

A. Provide forming and damming materials and sleeves as required by the firestopping system installation instructions.

PART 3 - EXECUTION

3.1 GENERAL:

A. Review all project drawings, Owner’s records and existing conditions to determine location, rating, and construction of all fire resistive construction.

B. Coordinate location of penetrations to allow for the maximum and minimum annular space around the penetrating item. Allow a minimum of 1" undisturbed building material between penetrations, or provide a firestopping system listed for multiple penetrations. Penetrating items shall be centered in hole as much as practical, unless firestopping system is listed for point contact between the wall/floor assembly and the penetrating item.

C. Neatly form, saw cut, hole saw or core drill openings. Size openings to conform with the maximum and minimum annular space requirements of the firestopping system.

3.2 APPLICATION:

A. The Contractor shall determine the most appropriate firestopping system which complies with these specifications.

B. All insulation shall be continued through the penetration. Provide intumescent caulk or collar firestopping systems. Where the insulation thickness specified in Section 23 07 00 exceeds the allowable insulation thickness for the firestopping system, reduce the insulation thickness 6 inches on either side of the penetration. Do not reduce insulation to less than 50 percent of the specified thickness.

C. Provide collar type firestopping systems where shown on drawings, and for hot piping systems at penetrations where significant thermal movement can be expected, such as near expansion compensation loops or joints.

D. Provide a firestopping system for ducts penetrating fire resistive construction without fire or fire/smoke dampers.

1. Do not provide firestopping between fire or fire/smoke damper sleeves and the opening.

E. Anchor wiring not within conduit on each side of a penetration to prevent it from being pulled out of the firestopping system.

F. See Section 23 05 18 for sleeves. The use of sleeves may affect the "T" rating of the firestopping system. Coordinate use of sleeves with firestopping.

END OF SECTION 230509

SECTION 230510 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUBMITTALS:

A. Refer to Division 1 and Section 23 05 00 “Common Work Results for Mechanical” for administrative and procedural requirements for submittals.

B. Product Data: Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.

C. Welding Certifications: Submit reports as required for piping work.

D. Brazing Certifications: Submit reports as required for piping work.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

C. Welding procedures and testing shall comply with the latest revisions of the applicable sections for B31, of the ANSI/ASME standard codes for pressure piping, noted as follows: B31.1 - Pressure Piping Code / B31.2 - Fuel Gas Piping Code / B31.5 - Refrigeration Piping / B31.9 - Building Service Piping Code.

D. Before any welding is performed, the contractor shall submit to the Architect/Engineer, or his authorized, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests and his Welding Procedure Specification together with the Procedure Qualification Record as required by ASME Boiler and Pressure Vessel Code.

E. Each manufacturer or contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.

F. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where

type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.2 STEEL PIPES AND PIPE FITTINGS:

A. Black Steel Pipe: ASTM A 53, Grade B, type E, electric resistance welded.

B. Galvanized Steel Pipe: ASTM A 53, Grade B.

C. Seamless Steel Pipe: ASTM A 53, Grade B, type S or A106 high temperature.

D. Cast-Iron Flanged Fittings: ANSI/ASME B16.1, including bolting (Class 125 and 250).

E. Cast-Iron Threaded Fittings: ANSI/ASME B16.4 (Class 125 and 250).

F. Malleable-Iron Threaded Fittings: ANSI/ASME B16.3; plain or galvanized as indicated (Class 125 and 300).

G. Malleable-Iron Threaded Unions: ANSI B16.39, Class 150, 250 or 300; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal- to-metal seats (iron, bronze or brass); plain or galvanized as indicated (Class 150, 250 and 300).

H. Threaded Pipe Plugs: ANSI/ASME B16.14.

I. Steel Flanges/Fittings: ANSI/ASME B16.5, ASTM A234 (Fire Protection) including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.
Material Group: Group 1.1.
End Connections: Buttwelding.
Facings: Raised-face.

J. Corrosion-Resistant Cast Flanges/Fittings: MSS SP-51, including bolting and gasketing (threaded where pressure is not critical).

K. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe (up to 4 inch pipe size).

L. Wrought-Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.

M. Cast-Iron Threaded Drainage Fittings: ANSI B16.12.

N. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.

O. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2 inches, and where pipe size is less than 1-1/2 inches, and do not thread nipples full length (no close-nipples).

2.3 COPPER TUBE AND FITTINGS:

A. Copper Tube: ASTM B 88; Type K or L as indicated for each service; hard-drawn temper, except as otherwise indicated.

B. DWV Copper Tube: ASTM B 306.

C. ACR Copper Tube: ASTM B 280.

D. Cast-Copper Solder-Joint Fittings: ANSI B16.18.

E. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

F. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).

G. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.

H. Cast-Copper Flared Tube Fittings: ANSI B16.26.

I. Bronze Pipe Flanges/Fittings: ANSI B16.24 (Class 150 and 300).

J. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.4 CAST-IRON SOIL PIPES AND PIPE FITTINGS:

A. Hubless Cast-Iron Soil Pipe: FS WW-P-401 and CISPI Standards 301 and 310. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.

B. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.

C. Hubless Cast-Iron Soil Pipe Couplings: Neoprene gasket complying with ASTM C564, CISPI Standard 310 and stainless steel clamp holding band.

D. Heavy Duty Hubless Cast Iron Soil Pipe Couplings: Neoprene gasket coupling with ASTM C564. 304 stainless steel shield, minimum 0.15 inches thick, minimum 3 inches wide with 4 sealing bands up to 4 inch pipe, minimum 4 inches wide with 6 sealing bands up to 10 inch pipe.

1. Basis of Design: Husky SD 4000.

E. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with ASTM A 74.

F. Neoprene Compression Gaskets: ASTM C 564.

2.5 PLASTIC PIPES AND PIPE FITTINGS:

A. Polyvinylchloride Sewer Pipe (PVC): ASTM D-2729, 2 inch thru 6 inch; ASTM D2665, 1-1/2 inches thru 8 inches.

2.6 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Soldering Materials: All soldering materials shall be lead free.

1. 95-5 Tin-Antimony: ASTM B 32, Grade 95TA. Melting Range 450-470 degrees F.
2. Silver-Tin Alloy: Fed. Spec. QQ-S-571E, NSFC2. Melting Range 430 to 530 degrees F.
3. Flux: All flux shall be lead free, water soluble, and compatible with the solder and the materials being joined. ASTM B813-93.

C. Brazing Materials: Except as otherwise indicated, provide brazing materials to comply with installation requirements.

1. Comply with AWSA 5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

a. Copper phosphorus -Bcup-5, 15 percent solver content, melting range 1190 to 1480 degrees F.
b. Silver - BAg-36, 45 percent silver, cadmium-free. Melting range 1195 to 1265 degrees F.

D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

E. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

1. Manufacturer: Subject to compliance with requirements, provide piping connectors of the following:

a. Husky Technologies (Husky SD 4000):

F. Pipe Thread Sealant Material: Except as otherwise indicated, provide all pipe threads with the sealant material as recommended by the manufacturer for the service.

1. Manufacturer: Subject to compliance with requirements, provide piping thread sealant material of the following:

a. The Rectorseal Corporation

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, and original design, and the referenced standards.

B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION:

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leak-proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerance.

1. Comply with ANSI B31 Code for Pressure Piping.
2. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.
3. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
4. Use fittings for all changes in direction and all branch connections.
5. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
6. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
7. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
8. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
9. Install drains in pressure pipe systems at all low points in mains, risers, and branch lines consisting of a tee fitting, ¾ inch ball valve, and short ¾ inch threaded end nipple and cap with chain.
10. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
11. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Division 23, Sections 23 05 18 and 23 05 09 for materials.
12. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals (See Section 23 05 18). Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
13. Anchor piping to ensure proper direction of expansion and contraction.

14. Coordinate foundation and all other structural penetrations with structural engineer.

B. Hydronic Piping:

1. Make reductions in hydronic pipe sizes using eccentric reducer fitting installed with the level side up.
2. Install hydronic piping branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line. Install all hydronic piping level with manual air vent at all high points in direction of flow.
3. Install hydronic piping level except for gravity flow systems such as condenser water and condensate drain piping.

C. Sanitary Waste and Vent; Roof Drain and Storm Drain Piping:

1. Install plumbing drainage piping with ¼ inch per foot (2 percent) downward slope in direction of drain for piping 3 inches and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install cast iron pipe in accordance with the Cast Iron Soil Pipe Institute Handbook.
2. Install 1 inch thick extruded polystyrene over underground drainage piping that is above frost line and not under building. Provide width to extend minimum of 12 inches beyond each side of pipe. Install directly over pipe, centered on pipe center line.
3. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. SANITARY CROSSES OR SHORT QUARTER BENDS SHALL NOT BE USED IN DRAIN PIPING.
4. Provide thrust restraints (bracing to structure or rodded joints) at branches and changes in direction for cast iron pipe 5 inches and larger suspended within the building.
5. Where cast iron piping is suspended in excess of 18 inches on single rod hangers, sway bracing shall be provided to prevent shear at the joints.
6. Install underground drain piping to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual.
7. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
8. Place bell ends or groove ends of piping facing upstream.
9. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
10. Install sub-surface drain piping according to requirements of the soils engineers requirements when required and connect to storm sewer / sump pump.
11. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
12. Remove unstable, soft, and unsuitable materials at the surface upon which pipes shall be laid, and backfill with clean sand or pea gravel to indicated invert elevation.
13. Shape bottom of trench to fit the bottom 1/4 of the circumference of pipe. Fill unevenness with tamped sand. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

D. Condensate Drain Piping:

1. Condensate drain piping from air conditioning unit coil condensate drain pan shall be of the sizes shown on the drawings.

E. Plastic Pipe:

1. All plastic piping installed below grade shall meet ASTM D2321-89 requirements.

3.3 PIPING SYSTEM JOINTS:

A. General: Provide joints of type indicated in each piping system.

B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

C. Braze copper tube-and-fitting joints in accordance with ASME B31.

D. Solder copper tube-and-fitting joints with silver solder or 95-5 tin-antimony. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

E. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31. Provide weld-o-let fittings for two pipe sizes less than main pipe size.

F. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Weld pipe joints only when ambient temperature is above 0 degrees F (-18 degrees C) where possible.
2. Bevel pipe ends at a 37.5 degrees angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
3. Use pipe clamps or tack-weld joints with 1 inch long welds; 4 welds for pipe sizes to 10 inches, 8 welds for pipe sizes 12 inch to 20 inch.
4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non- metallic inclusions.
5. Do not weld-out piping system imperfections by tack- welding procedures; refabricate to comply with requirements.

G. Weld pipe joints of steel water pipe in accordance with AWWA C206.

H. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

I. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions. Use pre-set torque wrench set to 80 in-lbs on heavy duty couplings.

3.4 PIPING APPLICATION:

A. Domestic Hot and Cold Water - Inside Building:

1. Above Grade Inside Building:

a. 6 inches and Smaller: Type L, hard drawn copper tube with wrought copper or bronze fittings, 95-5 tin-antimony soldered joints.

B. Sanitary Drainage and Vents - Inside Building:

1. Above Grade: Service weight cast iron, no-hub type with neoprene gaskets; service weight cast iron, hub and spigot type with neoprene gaskets; or DWV copper with wrought copper of cast brass fittings.

    a. Provide husky series 4000 couplings for waste pipe above critical spaces including:
        1) Food Service
        2) Operating Rooms
        3) Central Sterile Supply
        4) Electrical Rooms
        5) Communication Rooms
        6) Imaging Rooms

2. Below Grade: Sizes 2 inch to 20 inch, service weight cast iron, hub and spigot type only with neoprene compression gaskets; or sizes 12 inches and larger ductile cast iron with neoprene gasket joints; or sizes 2 inch to 16 inch, ASTM D2665 Schedule 40 Solid Wall PVC Sewer Pipe with solvent cement joints.

C. Heating Water, Chilled Water and Condenser Water Piping:

1. 2 Inches and Smaller:

    a. Schedule 40, black steel with 125 lb. cast iron or 150 lb. malleable iron threaded fittings or Type L or K copper, hard drawn copper wrought copper or bronze fittings, silver – tin alloy solder joints.

2. 2-1/2 Inches and Larger:

    a. Schedule 40, seamless or ERW (std. weight 12 inches and over) black steel with flanged or welded joints.
    b. Fittings: Standard weight / Extra strong, seamless steel, butt weld type.
    c. Flanges: 150 lb. 300 lb. forged steel slip-on or welding neck type.
    d. Bolting: Regular square head machine bolts with heavy hexagonal nuts.
    e. Gaskets: Thickness, material and type suitable for fluid to be handled, and design temperature and pressures.

D. Equipment Drains and Overflows:

1. Type "M" or "DWV" copper.

3.5 EXPOSED PIPING IN FINISHED AREAS:

A. Plumbing piping and fittings which are exposed (and uninsulated) in finished areas generally occupied by people including, but not limited to, kitchens, animal cagewash/equipment washing rooms, hospital autoclave or sterilizing rooms shall be installed with 17-gauge tubular brass with smooth, high polish, durable chrome plated finish.

3.6 PIPING TESTS:

A. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each section of each piping system independently but do not use piping system

valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

B. Test all piping systems as specified. Correct leaks by remaking joints. Remove equipment not able to withstand test procedure during test.

C. Work to be installed shall remain uncovered until the required tests have been completed.

D. Piping which is to be concealed shall be tested before being permanently enclosed.

E. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.

F. Give a minimum of twenty-four hours' notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of representative of owner, agency having jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.

G. Contractor shall obtain certificates of approval, acceptance and compliance with regulations of agencies having jurisdiction. Work shall not be considered complete until such certificates have been delivered by the Engineer to the Owner.

H. All costs involved in these tests shall be borne by Contractor.

I. System Tests

1. Hydrostatic Test: The test shall be accomplished by hand pumping the system to the specified water pressure, and maintaining that pressure until the entire system has been inspected for leaks, but in no case for a time period of less than four hours.

    a. Domestic water systems: 100 psig or 150 percent of system pressure, whichever is greater.
    b. Heating water: 100 psig or 150 percent of operating pressure, whichever is greater.
    c. Chilled water: 100 psig or 150 percent of system pressure, whichever is greater.
    d. Condenser water: 100 psig or 150 percent of system pressure, whichever is greater.

2. Waste, Drain and Vent Piping: All waste and vent piping, including building drain, roof drain and building sewer, shall be subjected to a water test. All openings in the piping system shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts; the system shall then be tight to all points. No section shall be tested with less than a ten foot head of water. Roof drain shall be closed at the lowest point and filled with water to the point of overflow.
3. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
4. Drain test water from piping systems after testing and repair work has been completed.

3.7 ADJUSTING AND CLEANING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water

before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.

B. Disinfect all potable water mains and water service piping in accordance with local and health department requirements. Submit test results report.

C. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

D. Chemical Treatment: Provide hydronic systems with a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3.8 COMMISSIONING:

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position. Close coil bypass valves.
2. Remove and clean strainers.
3. Check pump for proper rotation and proper wiring.
4. Set automatic fill valves for required system pressure.
5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Check operation of automatic bypass valve.
8. Check and set operating temperature of boilers, chillers, and cooling towers to design requirements.
9. Lubricate motors and bearings.

END OF SECTION 230510

SECTION 230518- PIPING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of piping specialties work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Piping specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".
2. ASME B 31.9 "Building Services Piping" for materials, products, and installation.
3. Safety valves and pressure vessels shall bear the appropriate ASME label.
4. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
5. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Pipe Escutcheons:

a. Chicago Specialty Mfg. Co.
b. Producers Specialty & Mfg. Corp.
c. Sanitary-Dash Mfg. Co.

2. Low Pressure Strainers:

a. Armstrong International
b. Hoffman Specialty
c. Metraflex Co.
d. R-P&C Valve.
e. Spirax Sarco.
f. Victaulic Co. of America.
g. Watts Regulator Co.
h. Keckley

3. Dielectric Waterways

a. Victaulic Co.
b. Perfection Corp.
c. Flow Design Inc.
d. Precision Plumbing Products
e. Rockford-Eclipse Div.

2.2 HYDRONIC PIPING SPECIALTIES:

A. Coin Operated Manual Air Vent: Bronze body and nonferrous internal parts; 150 psig working pressure, 212 degrees F operating temperature; manually coin operated and having discharge outlet connection and 1/8 inch NPT male connection.

B. Manual Air Vent: Provide ball valves as specified in Part 3.

2.3 PIPE ESCUTCHEONS:

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

2.4 LOW PRESSURE PIPELINE STRAINERS:

A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screen. Two inches and smaller steam and liquid strainers shall have 20 mesh screens. Provide 3/64 inch perforations for 2-1/2 inch and 3 inch steam and liquid strainers. Provide 1/8 inch mesh perforations for 4 inches and larger liquid strainers. Provide 1/16 inch mesh perforations for 4 inches and larger steam strainers.

B. Threaded Ends, 2 inch and Smaller: Bronze or Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.

C. Threaded Ends, 2-1/2 inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

D. Flanged Ends, 2-1/2 inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

2.5 DIELECTRIC WATERWAY:

A. General: Zinc electroplated nipple with non-metallic lining for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion. Union style not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES:

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Strainers: Install strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff full port ball valve with ¾ inch hose end and cap in strainer blow down connection. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection.

1. Provide strainers in supply line ahead of the following equipment, and elsewhere as indicated.

a. Control valves

C. Dielectric Waterway: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

1. Not required in closed hydronic systems treated with corrosion inhibitors, where there is a bronze valve body between the two materials.

3.2 HYDRONIC SPECIALTIES INSTALLATION:

A. Manual Air Vent: Provide manual air vents at all high points and drops in the direction of flow, of all mains and risers of the hydronic systems, at heat transfer coils, radiation and elsewhere shown and as required for system air venting.

1. Provide enlarged air collection standpipe where large air quantities can accumulate.
2. Use a 1/2 inch ball valve with a soft copper tubing discharge pipe directed to a convenient collection point except as noted below.
3. Use a coin operated air vent inside terminal unit and baseboard radiation enclosures.

END OF SECTION 230518

SECTION 230519 - METERS AND GAUGES FOR MECHANICAL PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of meters and gauges required by this section is indicated on drawings and/or specified in other Division-23 sections.

B. Meters and gauges furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of meters and gauges, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

C. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

B. All flow measuring devices to be provided shall be reviewed and approved by the test & balance contractor and the temperature control contractor for proper scale, rangeability and function prior to submitting shop drawings. The test & balance contractor and temperature control contractor shall provide a typed letter stating this review has been completed and included with shop drawing submittals.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data and product data in Maintenance Manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Calibrated Balancing Valves (Valve and Venturi Type):

a. Flow Design Inc.
b. Presso
c. Gerand
d. Nexus Valve
e. Griswold
f. Hays
g. NuTech

2.2 CALIBRATED BALANCE VALVES:

A. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout port with a quick connect valve designed to minimize system fluid loss during monitoring process. Provide balance valves with preformed insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment. Calibrated balance valves packages may combine additional features shown on the drawings such as strainers, P/T ports, drain valves, etc as long as those features are equivalent to the specification of the individual component.

B. Body – Dezincification resistant brass.

C. All valves used on domestic water systems shall conform to NSF/ANSI 61 and shall be listed as a NSF Certified Drinking Water System Component.

D. Design, variable orifice type:

1. Globe-type valve.
2. Multiple turns of handwheel from full closed to full open.
3. Bubble-tight shut-off.
4. Schraeder type taps upstream and downstream.
5. Memory stop device to allow valve to be returned to balanced position after being closed. (Note: this does not take the place of isolation valves shown on drawings)
6. Provide slide rule type flow calculator, include in Operation and Maintenance Manual.

E. Design, valve and venturi type:

1. Ball or butterfly type throttling valve with stainless steel ball.
2. Bubble-tight shut-off.
3. Fixed venturi, upstream of valve.
4. Schraeder type taps on venturi, upstream and downstream.
5. Memory stop device to allow valve to be returned to balanced position after being closed. (Note: this does not take the place of isolation valves shown on drawings)
6. Provide metal tag with flow curve for each valve.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF FLOW MEASURING METERS:

A. General: Install flow measuring meters on piping systems located in accessible locations at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated.

1. At discharge of each pump.
2. At inlet of each hydronic coil.

C. Wafer-Type Flow Meters: Install between 2 Class 125 pipe flanges, ANSI B16.1 (cast-iron) or ANSI B16.24 (cast- bronze). Provide minimum straight lengths of pipe upstream and downstream from meter in accordance with manufacturer's installation instructions.

D. Calibrated Balance Valves: Install on piping with readout valves in vertical upright position. Maintain minimum length of straight unrestricted piping equivalent to 3 pipe diameters upstream of valve.

3.3 ADJUSTING AND CLEANING:

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gauges and factory- finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION 230519

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SECTION 230523- GENERAL DUTY VALVES FOR MECHANICAL PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This Section includes general duty valves common to most mechanical piping systems.

B. Valves tags and charts are specified in Division 23 Section "Mechanical Identification."

1.2 SUBMITTALS:

A. Product Data: including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.3 QUALITY ASSURANCE:

A. Single Source Responsibility: Comply with the requirements specified in Division-23 Section "Basic Mechanical Requirements," under "Product Options."

B. MSS Standard Practices: Comply with the following standards for valves:

1. MSS SP-45: Bypass and Drain Connection Standard
2. MSS SP-67: Butterfly Valves
3. MSS SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends
4. MSS SP-71: Cast Iron Swing Check Valves, Flanged and Threaded Ends
5. MSS SP-72: Gray Valves with Flanged or Butt-Welding Ends for General Service
6. MSS SP-78: Cast Iron Plug Valves, Flanged and Threaded Ends
7. MSS SP-80: Bronze Gate, Globe Angle and Check Valves
8. MSS SP-85: Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
9. MSS SP-92: MSS Valve User Guide

C. Solenoid valves shall be UL listed, ANSI and CSA approved.

D. NSF Standard 61: Drinking Water System Components.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Preparation for Transport: Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rusting and galvanic corrosion.
2. Protect valve ends against mechanical damage to threads, flange faces and weld end preps.
3. Set valves in best position for handling. Globe and gate valves shall be closed to prevent rattling; ball and plug valves shall be open to minimize exposure of functional surfaces; butterfly valves shall be shipped closed or slightly open; and swing check valves shall be blocked in either closed or open position.

B. Storage: Use the following precautions during storage:

1. Valves shall be stored and protected against all dirt, debris and foreign material at all times.
2. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
3. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement and protect in watertight enclosures.

C. Handling: Valves whose size requires handling by crane or lift shall be slung or rigged to avoid damage to exposed valve parts. Handwheels and stems, in particular, shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by the manufacturers listed.

1. Ball Valves:

a. Apollo
b. Milwaukee
c. Nibco
d. Watts
e. Kitz

2.2 VALVE FEATURES:

A. General: Comply with MSS-92

B. All valves used on domestic water systems shall conform to NSF/ANSI 61 and shall be listed as a NSF Certified Drinking Water System Component.

C. Valve Design: Valves shall have rising stem, or rising stem outside screw and yoke design; except, non-rising stem valves may be used where headroom prevents full operation of rising stem valves.

D. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size. (Control valves shall be sized for required flow.)

E. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem for valves other than quarter turn.
2. Lever handle on quarter turn valves 6 inch and smaller, except plug valves. Provide a wrench for every plug valve.
3. Chainwheel operators for valves 2-1/2 inch and larger that are installed 96 inches or higher above finished floor elevation. Provide chains to an elevation of 6'-0" above finished floor elevation.

4. Worm gear operators of an enclosed weather-proof design shall be provided on all quarter turn valves 8 inches and larger.

F. Extended Stems: Where insulation is indicated or specified, provide extended stems to allow full operation of the valve without interference by the insulation.

G. Bypass and Drain Connections: Comply with MSS SP-45.

H. End Connections: As specified in the individual valves specifications.

1. Threads: Comply with ANSI B2.1.
2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze.
3. Solder-Joint: Comply with ANSI B16.18.

a. Caution: Where soldered end connections are used, use solder having a melting point below 840 degrees F for gate, globe, and check valves and below 421 degrees F for ball valves.

2.3 BALL VALVES FOR HYDRONIC SYSTEMS:

A. Ball Valves: 150 WSP, 600 WOG, rated for 150 PSI at 350 degrees F, two piece end entry body style, bronze body conforming to ASTM B584, full port chrome plated brass ball, 15% glass reinforced PTFE seats, PTFE packing, adjustable packing nut blow-out proof stem, vinyl covered steel handle. Provide solder ends or threaded ends to match piping system. Stem length to allow handle to clear insulation. Valves shall have a C_v value of a full port ball valve. Comply with NSF-61. Apollo 77C-100/200

B. Ball Valves for all silver soldered or brazed lines: ANSI B16.34, 150 WSP, 600 WOG, rated for 150 PSI at 350 degrees F. , Three piece body style for brazed lines, bronze body conforming to ASTM B584, full port, chrome plated brass ball and stem of ASTM A276 type 316, 15% glass reinforced RTFE seats, RTFE packing and blow out proof stem, vinyl coated steel handle. Stem length to allow handle to clear insulation. Provide solder ends. Valves shall have a C_v value of a full port ball valve. Apollo 82-200.

2.4 BALL VALVES FOR PLUMBING SYSTEMS:

A. Lead Free Ball Valves: 150 WSP, 600 WOG, rated for 150 PSI at 350 degrees F, two piece end entry body style, lead free bronze body conforming to ASTM B584, full port chrome plated brass ball, 15% glass reinforced PTFE seats, PTFE packing, adjustable packing nut blow-out proof stem, vinyl covered steel handle. Stem length to allow handle to clear insulation. Provide solder ends or threaded ends to match piping system. Valves shall have a C_v value of a full port ball valve. Comply with NSF-61. Apollo 77CLF-100/200

B. Lead Free Ball Valves for all brazed lines: ANSI B16.34, 150 WSP, 600 WOG, rated for 150 PSI at 350 degrees F. Three piece body style, bronze body conforming to ASTM B584, full port, chrome plated brass ball and Lead Free Brass stem , 15% glass reinforced RTFE seats, RTFE packing and blow out proof stem, vinyl coated steel handle. Stem length to allow handle to clear insulation. Solder ends to. Valves shall have a C_v value of a full port ball valve. Apollo 82LF200

2.5 BALL VALVE OPTIONS/ACCESSORIES:

A. Provide the following as required or as specifically indicated:

1. Tee handle for tight fit applications (within enclosures, etc.).
2. Locking handle (emergency fixtures, etc).
3. Drain cap (drain valves).
4. Stem extension where the stem otherwise would not clear the insulation thickness..
5. Mounting pads (actuated valves).

2.6 DRAIN VALVES:

A. For Hydronic and Plumbing Systems: Provide ball valve with threaded hose end and cap with chain.

1. Apollo Fig. 78-165-01

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Install valves in accordance with manufacturer's instructions.

B. Examine valve interior through the end ports, for cleanliness, freedom from foreign matter and corrosion. Remove special packing materials, such as blocks used which prevents disc movement during shipping and handling.

C. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the position in which it was shipped.

D. Examine threads on both the valve and the mating pipe for form (out-of-round or local indentation) and cleanliness.

E. Examine mating flange faces for conditions which might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size and material, and for freedom from defects and damage.

F. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

3.2 VALVE SELECTION:

A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size 2 Inch and Smaller: Solder ends, except in heating hot water and low pressure steam service which shall have threaded ends.
2. Steel Pipe Sizes 2 Inch and Smaller: Threaded or grooved-end.
3. Steel Pipe Sizes 2-1/2 Inch and Larger: Flanged or grooved end.

4. At all piping hot taps provide a ball valve with the hot tap and a ball valve or butterfly valve for shut-off service. Hot taps shall be provided only where approved by the Engineer.

3.3 VALVE INSTALLATIONS:

VALVE APPLICATION TABLE	
(Where sizes overlap, contractor has choice of either type)	
SERVICE	VALVE TYPE
Plumbing Water Services; 3" or smaller	Ball Valve
Plumbing Balancing Service;	Calibrated Balancing Valve See Section 23 05 19
HVAC Hydronic Piping; 3" and smaller	Ball Valve
HVAC Hydronic Balancing valve; 2" and smaller	Calibrated Balancing Valve See Section 23 05 19

A. Locate valves for easy access and provide separate support where necessary.

B. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.

C. Install 3-valve bypass around each pressure reducing valve using throttling type valves.

D. Gate and globe valves shall be installed with the stem in the upright position. In overhead horizontal piping, ball valves shall be installed with the handle in the side or bottom of the piping. Butterfly valves shall be installed with the stem within 45 degrees of the horizontal position. The handle of quarter turn valves shall open in the direction of flow. Quarter turn valves with hand wheels or chain wheels shall be located so that the position indicator is visible from the floor without the use of a ladder or climbing on equipment or piping.

3.4 SOLDER CONNECTIONS:

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket, using steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves with composition discs.

F. Insert tube into valve socket making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to insure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating the valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.5 BRAZED CONNECTIONS:

A. Protect valves from temperatures which exceed the valve material temperature limitations as recommended by the valve manufacturer.

B. Disassemble 3 piece ball valves prior to brazing.

3.6 THREADED CONNECTIONS:

A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

D. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.7 FLANGED CONNECTIONS:

A. Align flanges surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using a torque wrench.

3.8 FIELD QUALITY CONTROL:

A. Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

3.9 ADJUSTING AND CLEANING:

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR MECHANICAL PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
2. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system.
3. Duct Hangers: SMACNA Duct Manuals
4. MSS Standard Compliance:

    a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.

1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

    a. Erico

2. Saddles, Shield and Thermal Shield Inserts:

   a. Erico

3. Concrete Inserts and Anchors:

   a. Unistrut Metal Framing Systems
   b. Power-Strut
   c. ITW Ramset/Red Head
   d. Hilti
   e. B-Line
   f. Erico
   g. Grinnell

2.2 PIPE HANGERS & SUPPORTS:

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-69.

   1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
   2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Adjustable Clevis Hanger: MSS Type.

   1. Steel Pipe, size 3/8" thru 30", Type 1.
   2. Non-insulated Copper Pipe, size 1/2" thru 4", Type 1. (PVC Coated)
   3. Cast Iron Pipe, size 4" thru 24", Type 1.

C. Adjustable Swivel Ring for Non-insulated Pipe: MSS Type .

   1. Steel Pipe, size 1/2" thru 8", Type 7.
   2. Copper Pipe, size 1/2" thru 4", Type 7 (PVC Coated)

D. Pipe Clamps: MSS Type .

   1. Steel Pipe, size 3/4" thru 24", Type 8.
   2. Copper Pipe, size 1/2" thru 4", Type 8 (PVC Coated).

E. U Bolts: MSS Type .

   1. Steel Pipe, size 1/2" thru 30" Type 24
   2. Copper Pipe, size 1/2" thru 8", Type 24 (PVC Coated).

F. Straps: MSS Type 26.

G. Pipe Stanchion Saddle: MSS Type 37.

H. Yoke & Roller Hanger: MSS Type 43

I. Hanger Rods: Continuous threaded steel, sizes as specified.

J. Hangers:

1. Hot Pipes:

   a. 1/2" through 1-1/2": Adjustable wrought steel ring.
   b. 2" through 5": Adjustable wrought steel clevis.
   c. 6" and Over: Adjustable steel yoke and cast iron roll.

2. Cold Pipes:

   a. 1/2" through 1-1/2": Adjustable wrought steel ring.
   b. 2" and Over: Adjustable wrought steel clevis.

3. Multiple or Trapeze: Structural steel channel (with web vertical and engineered for the specific applications), with welded spacers and hanger rods. Provide cast iron roll and base plate for hot pipe sizes six inches and over. Provide hanger rods one size larger than for largest pipe in trapeze. If the deflection at center of trapeze exceeds 1/360 of the distance between the end hangers, install an additional hanger at mid-span or use a larger channel.

K. Wall Supports for Horizontal Steel Pipe:

1. ½ inch through 4inches: Offset or straight j-hook.
2. 4 inches and Over: Welded steel bracket Type 31, 32 or 33 and wrought steel clamp. Provide adjustable steel yoke and cast iron roll Type 44 for hot pipe 200 degrees F and over and for sizes six inches and over.

L. Supports for Vertical Pipe: Steel riser clamp. Type 8.

M. Upper Attachments:

1. For attaching hanger rods to structural steel I-beams:

   a. Provide adjustable beam clamp, MSS-Type 21. Attach to bottom flange of beam.

2. For attaching hanger rods to bar joists:

   a. When bottom chord is constructed of structural steel angles, provide square washer. Place hanger rod between backs of the two angles and support with the washer and dual locking nuts on top of the angles. Spot weld washer to angles.
   b. When bottom chord is constructed of round bars, provide Elcen No. 137 bar joint washer or equal.

2.3 CONCRETE INSERTS AND ANCHORS:

A. Inserts: Case shall be of galvanized carbon steel with square threaded concrete insert nut for hanger rod connection; top lugs for reinforcing rods, nail holes for attaching to forms. This type of upper attachment is to be used for all areas having poured in place concrete construction.

1. Size inserts to suit threaded hanger rods.

B. Provide fasteners attached to concrete ceilings that are vibration and shock resistant. Provide hangers for piping attached to concrete construction with one of the following types.

1. Concrete insert per MSS SP 69, Type 18.

2. Powder driven fasteners subject to approval of Architect and Structural Engineer. Each fastener shall be capable of holding a test load of 1000 pounds whereas the actual load shall not exceed 50 pounds.
3. Self-drilling expansion shields. The load applied shall not exceed one-fourth the proof test load required.
4. Machine bolt expansion anchor. The load applied shall not exceed one-fourth the proof test load required.

C. Anchors: Carbon steel, zinc plated and coated with a clear chromate finish. Installation shall be in holes drilled with carbide-tipped drill bits or by use of self-drilling anchors.

1. Provide anchors suitable for the location of installation and designed to withstand all forces and movements acting in the anchor. Manufacture pipe anchors in accordance with MSS SP 69. Provide a safety factor of four for the anchor installation.

2.4 SADDLES AND THERMAL SHIELD INSERTS:

A. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

B. Protection Shields: MSS Type 40; 180 degrees arc, galvanized steel, minimum 12 inches long, to prevent crushing of insulation.

C. Thermal Shield Inserts: Provide 100-psi minimum compressive strength, waterproof, asbestos free calcium silicate, encased with a sheet metal enclosure. Insert and shield shall cover the entire circumference or the bottom half circumference of the pipe as required by Part 3 of this Specification, and shall be of length recommended by the manufacturer for pipe size and thickness of insulation. For cold piping, calcium silicate shall extend beyond the sheet metal shield to allow overlap of the vapor barrier. Where piping 4 inches and larger is supported on trapeze or pipe rollers, provide double thickness shields. For piping 12 inches and over, provide 600 psi calcium silicate structural insert.

2.5 MISCELLANEOUS MATERIALS:

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

D. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION:

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified. Provide Shop Drawing showing method and support locations from structure.

3.3 INSTALLATION OF BUILDING ATTACHMENTS:

A. Install building attachments within concrete or on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. New Construction:

1. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
2. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inches or ducts over 60 inches wide.
3. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
4. Where inserts are omitted drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab if construction above permits.

C. Existing Construction:

1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod. Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

3.4 INSTALLATION OF HANGERS AND SUPPORTS:

A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to

be supported together on field fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

C. Support fire-water piping independently from other piping systems.

D. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers are not acceptable.

E. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, to facilitate action of expansion joints, expansion loops, expansion bends and similar units and within 1'-0" of each horizontal elbow.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.

H. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Saddles: Install Protection saddles where supported by pipe rollers. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install galvanized steel protection shields, on all insulated piping 2 inches and less, except where required to be clamped. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "Zip Strips".
4. Thermal Inserts: Provide thermal shield inserts at all supports for all insulated piping over 2 inches and for all piping required to be clamped. Provide 180 percent inserts at clevis and roller hangers. Provide 360 percent inserts for all trapeze and clamped supports.

I. Install horizontal hydronic and steam piping with the following minimum rod sizes and maximum spacing:

SIZE (NPS)	MAX. SPAN IN FEET		MIN. ROD SIZE-INCHES
	Steel	Copper	
1	7	6	3/8
1-1/2	9	8	3/8
2	10	8	3/8
3	12	10	1/2
4	14	12	5/8
5	16	13	5/8

SIZE (NPS)	MAX. SPAN IN FEET		MIN. ROD SIZE-INCHES
	Steel	Copper	
6	17	14	3/4

J. Support horizontal cast iron pipe as follows:

1. Hub & Spigot: All sizes.

   a. 10 ft. max spacing: min of one (1) hanger per pipe section close to joint on the barrel. Also at change of direction and branch connections.
   b. Support vertical cast iron pipe at each story height and at its base. Secure vertical hub and spigot pipe immediately below the hub.
   c. Use hanger rods same size as for steel pipe.

2. No-Hub: All sizes

   a. With Clamp-All and Anaheim Series 4000 stainless steel couplings and MG cast iron couplings: one hanger to each joint.
   b. With all other stainless steel band type couplings: one hanger to each side of joint.
   c. Support all horizontal cast iron pipe within 18 inches of each joint and with 5 feet maximum spacing between hangers, except that pipe exceeding 5 feet in length shall be supported at intervals no greater than 10 feet.
   d. Use hanger rods same size as for steel pipe.
   e. Support vertical cast iron pipe at each story height and at its base. Support vertical no-hub pipe so that the weight is carried from the pipe to the support and not from the joint to the support.

K. Place a hanger within one foot of each horizontal elbow.

L. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.

M. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.

N. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.

O. Where practical, support riser piping independently of connected horizontal piping.

P. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.

Q. Securely anchor and support plumbing domestic water piping in chases or walls. Use factory manufactured clamps and brackets connected to fixture s, waste/vent piping or brackets connected to studs. Wires or straps will not be permitted.

1. When copper supplies are connected to flush valves, support the tubing by the studs or by a fixture, not by clamping to waste/vent piping.
2. Prevent copper tubes from making contact with steel brackets using fire retardant polyethylene inserts or other dielectric insulating material. Duct tape shall not be used.

R. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:

1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.
2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than 6 inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any 50 successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.
3. Hangers for piping and ducts shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

3.5 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31.9, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping. Provide shop drawing for review by Engineer.

3.6 SHEET METAL DUCT HANGERS AND SUPPORTS:

A. Provide in accordance with SMACNA HVAC duct construction standards.

1. Duct in exposed spaces shall use single-line, air-craft cable duct hangers of equivalent strength as SMACNA HVAC Duct Construction Standards.

B. Additional Hanger Requirements:

1. 2" to 24" from flexible connections of fans.
2. 2" to 24" from the outlets or flexible connections of VAV control units or mixing boxes.
3. 12" to 36" from the main duct to the first hanger of long branch ducts.
4. 2" to 12" from the ends of all branch ducts and linear diffuser plenums.
5. 2" to 24" from fire damper break-away joints.
6. Hangers at throat and heal of round or square elbows 48" or greater in width.

3.7 EQUIPMENT SUPPORTS:

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

C. Concrete bases for the mechanical equipment indoors or outdoors will be provided by the General Contractor only if shown on the architectural or structural drawings. Otherwise, all bases shall be provided by this Contractor.

D. For inertia bases, see Section 23 05 48 “Vibration and Seismic Controls for Mechanical Piping and Equipment”.

E. Housekeeping bases shall be 4 inches thick minimum, extended 4inches beyond machinery bedplates.

F. This Contractor shall be responsible for the proper size and location of all bases and shall furnish all required anchor bolts and sleeves. If bases are provided by the General Contractor, furnish him with templates showing the bolt locations.

G. Equipment shall be secured to the bases with anchor bolts of ample size. Bolts shall have bottom plates and pipe sleeves and shall be securely imbedded in the concrete. All machinery shall be grouted under the entire bearing surface. After grout has set, all wedges, shims and jack bolts shall be removed and the space filled with non-shrinking grout. This Contractor shall provide lead washers at all equipment anchor bolts.

H. Construct equipment supports above floor of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

I. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment. See also Section 23 05 48 “Vibration and Seismic Controls for Mechanical Piping”.

3.8 METAL FABRICATION:

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours at welded surfaces match adjacent contours.

3.9 ADJUSTING:

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Cut off the bottom of threaded rods so they are no more than one rod diameter below the bottom nut.

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230540- VIBRATION CONTROL FOR MECHANICAL PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division-23 sections.

B. Types of vibration control products specified in this section include the following:

1. Fiberglass Pads and Shapes
2. Neoprene Pads
3. Vibration Isolation Springs
4. All-Directional Anchors
5. Neoprene Mountings
6. Spring Isolators, Free-Standing
7. Spring Isolators, Vertically-Restrained
8. Thrust Restraints
9. Equipment Rails
10. Fabricated Equipment Bases
11. Inertia Base Frames
12. Roof-Curb Isolators
13. Isolation Hangers
14. Riser Isolators
15. Flexible Pipe Connectors

C. Vibration control products furnished as integral part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

D. Refer to other Division 23 sections for equipment foundations; hangers; sealants; gaskets; requirements of electrical connections to equipment isolated on vibration control products; requirements of duct connections to air handling equipment isolated on vibration control products.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

1. Except as otherwise indicated, obtain vibration control products from single manufacturer.
2. Engage manufacturer to provide technical supervision of installation of support isolation units produced, and of associated inertia bases (if any).

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

1. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.
2. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics, ratio of horizontal to vertical stiffness and bases of spring-rated selection for range of loading weights.
3. Include performance certifications from manufacturers.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoring points, coordinated with equipment manufacturer's shop drawings.

1. Shop drawings showing structural design and details of inertia bases, steel beam bases and other custom-fabricated work not covered by manufacturer's submitted data.

a. Furnish templates, anchor bolts and sleeve for equipment bases, foundations and other support systems for coordination of vibration isolation units with other work.

2. Submit shop drawings indicating scope of vibration isolation work and locations of units and flexible connections. Include support isolation points for piping and ductwork including risers, air housings and inertia bases.

a. Include schedule of units, showing size or manufacturer's part number, and weight supported and resulting deflection of each unit.

C. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data and shop drawings in maintenance manual; in accordance with requirements of Divisions 23.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 120 MPH.
2. Building Classification Category: III.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 NOISE CRITERIA

A. Noise levels due to mechanical or electrical equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall not exceed sound pressure levels in all 8 octave bands corresponding to NC levels per ASHRAE handbook as indicated:

1. Executive Dining: NC-30
2. Private Offices: NC-35

3. Reading Room: NC-35
4. Dining and Student Lounge: NC 35-40
5. Lobbies: NC-40
6. Food Prep and Servery: NC-40
7. Corridors: NC-40
8. Fitness: NC-40

B. Penetrations by ducts, pipes and conduit for partitions and slabs within areas designated NC 25-35, those rooms with slab-to-slab acoustical partitions, and within mechanical and electrical rooms/areas shall be packed and sealed airtight with a non-hardening sealant as described herein.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Vibration Control Products:

a. Amber/Booth Company, Inc.
b. Kinetics Noise Control
c. Mason Industries, Inc.
d. VMC Group

2.2 VIBRATION CONTROL MATERIALS AND SUPPORT UNITS:

A. Fiberglass Pads and Shapes: Glass fiber of not more than 0.18 mil diameter, produced by multiple-flame attenuation process, molded with manufacturer's standard fillers and binders through 10 compression cycles at 3 times rated load bearing capacity, to achieve natural frequency of not more than 12 Hertz, in thicknesses and shapes required for use in vibration isolation units.

B. Neoprene Pads: Oil-resistant neoprene sheets of manufacturer's standard hardness and cross-ribbed or waffled pattern.

1. Mason Industries Type W.

C. Vibration Isolation Springs: Wound-steel compression springs, of high-strength, heat-treated, spring alloy steel with outside diameter not less than 0.8 times operating height; with lateral stiffness not less than vertical stiffness and designed to reach solid height before exceeding rated fatigue point of steel.

1. Color coated springs for ease of identification.
2. Spring shall have a minimum of 50 percent additional travel to solid.

D. All-Directional Anchors: Provide all-directional acoustical pipe anchor consisting of telescopic arrangement of sizes of steel tubing separated by minimum ½ inch thickness of heavy-duty neoprene and duck, or neoprene isolation material. Provide vertical restraints by similar material arranged to prevent vertical travel in either direction. Design for maximum 500 psi load on isolation materials, and provide for equal resistance in any direction. Equip anchor with

threaded hole on top and 2 holes in base plate for bolting down or provide welding provisions top and bottom, if indicated.

1. Mason Industries Type ADA.

E. Neoprene Mountings: Provide neoprene mountings consisting of neoprene element bonded between 2 steel plates that are neoprene-covered to prevent corrosion. Provide minimum rated deflection of 0.35 inches. Provide threaded hole in upper plate and 2 holes in base plate for securing to equipment and to substrate.

1. Mason Industries Type ND.

F. Spring Isolators, Free-Standing: Except as otherwise indicated, provide vibration isolation spring Type C between top and bottom loading plates, and with pad-type Type B isolator bonded to bottom of bottom loading plate. Include studs or cups to ensure centering of spring on plates. Include leveling bolt with lock nuts and washers, centered in top plate, arranged for leveling and anchoring supported equipment as indicated.

1. Include holes in bottom plate for bolting unit to substrate as indicated.
2. Mason Industries Type SLFH.

G. Spring Isolators, Vertically-Restrained: Provide spring isolators Type C in housing that includes vertical limit stops. Design housing to act as blocking during erection, and with installed height and operating height being equal. Maintain ½ inch minimum clearance around restraining bolts, and between housing and springs. Design so limit stops are out of contact during normal operation.

1. Mounting used out of doors shall be hot dipped galvanized, spring shall be cadmium plated.
2. Mounting used out of doors shall have certified calculation by a registered professional engineer showing ability to withstand MPH wind load required by local codes in 3 principal axis.
3. Mason Industries Type SLR.

H. Thrust Restraints: Provide horizontal thrust restraints consisting of spring elements in series with neoprene pad. Select spring deflection same as for equipment loading. Design so thrust restraints can be pre-set and adjusted in field. Attach horizontal restraints at centerline of thrust and symmetrically on either side of unit.

1. Provide same deflection as isolated equipment.
2. Select load to provide ¼ inch maximum displacement under full system operating pressure.
3. Mason Industries Type WBI.

I. Equipment Rails: Where rails or beams are indicated for use with isolator units to support equipment, provide steel beams complying with ASTM A36, with minimum depth of 6 inches or 0.10 x span of beam between isolators (whichever is greater). Provide welded bracket at each end of beams, and anchor each end to spring isolator unit. Provide bolt holes in beams matching anchor bolt holes in equipment. Provide beams of section modules indicated or, if not indicated, selected for normal-weight equipment loading to limit static load stress to 16,000 psi.

1. Beam depth need not exceed 14 inches provided that deflection and misalignment is kept within manufacturer's acceptable limits.
2. Mason Industries Type ICS.

J. Fabricated Equipment Bases: Where supplementary bases are indicated for use with isolator units to support equipment (base not integral with equipment), provide welded rectangular unit, fabricated of structural steel shapes, plates and bars complying with ASTM A36. Provide welded support brackets and anchor base to spring isolator units. Except as otherwise indicated arrange brackets to result in lowest possible mounting height for equipment, but provide minimum of 1 inch. Provide bolt holes in base matching anchor bolt holes in equipment.

1. Provide for auxiliary motor slide base under motor or motor slide rails for adjusting belt tension. Design primary base for bolting of rails or slide base in position.
2. Where sizes of base framing members are not indicated, fabricate base with depth of structure not less than 0.10 x longest span of base, rigidly braced to support equipment without deflections or distortions which would be detrimental to equipment or equipment performance.
3. Beam depth need not exceed 14 inches provided that deflection and misalignment is kept within manufacturer's limits.
4. Mason Industries Type WF.

K. Inertia Base Frames: Where inertia bases are indicated for use with isolation units to support equipment, provide rectangular structural beam channel, or complete sheet metal box concrete forms for floating foundations, with materials complying with ASTM A36. Frame unit as shown or, if not shown, with minimum depth of 0.08 x longest dimension of base, but not less than 6 inches deep. Size frame as shown or, if not shown, so that weight of frame plus concrete fill will be greater than operating weight of equipment supported. Provide steel reinforcing both ways with both ends of reinforcing buttwelded to base framing.

1. Provide welded support brackets and anchor base frame to spring isolator units.
2. Provide anchor bolts, located as required for equipment anchorage and supported for casting of concrete. Locate bolts as indicated or, if not indicated, locate bolts so that operating weight of equipment will be centered both ways on inertia base.
3. Provide adjustable bolts in pipe sleeves.
4. Provide mounting bracket to provide 1 inch floor clearance.
5. Provide sufficient mass to allow ¼ inch maximum displacement under starting and normal conditions.
6. Mason Industries Type KSL.

L. Roof-Curb Isolators: Fabricated frame units sized to match roof curbs, formed with isolation springs Type C between extruded aluminum upper and lower sections, which are shaped and positioned to prevent metal-to-metal contact. Provide continuous airtight and waterproof seal between upper and lower extrusions. Include provisions for anchorage of frame unit to roof curb, and for anchorage of equipment to unit.

1. Mason Industries Type CMAB.

M. Isolation Hangers: Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for 5 times rated loading of units. Fabricate units to accept misalignment of 15 degrees off center in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.

1. Provide vibration isolation spring Type C with cap in lower pad-type isolator rubber hanger element in bottom, securely retained in unit.
2. Provide neoprene element, with minimum deflection of 0.35inch, securely retained in hanger box.
3. Mason Industries Type 30N.

N. Riser Isolators: Suspend risers from, or support risers by, spring hangers Type ND or spring isolators Type F. Wherever possible, anchor risers at central point with resilient anchors, Type D. Provide hanger or mounting deflection of 0.75 inches except in those expansion locations where additional deflection is required to limit deflection or load changes to +25 percent of initial deflection. Provide sliding guides held in position by resilient anchors, located between anchor points and end of piping, spaced as indicated.

O. Flexible Pipe Connectors:

1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
2. Mason Industries Type BBF.

a. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.
1) Mason Industries Type BSS.

P. Foam Rod

1. Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

Q. Non-Hardening Sealant

1. Sealant for penetrations shall be a permanently non-hardening type, such as Tremco Acoustical Sealant or equal.
2. Permanently flexible, approved firestop systems may be used for penetrations of fire-rated noise critical walls and slabs.

R. Packing Material for Penetrations

1. Mineral fiber, non-combustible, resistant to water, mildew and vermin.
2. USG Thermafiber, 2.5 pcf density, or equivalent product by Roxul, Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner or his representative.

3.2 PERFORMANCE OF ISOLATORS:

A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units to achieve minimum static deflection and displacement requirements.

3.3 APPLICATIONS:

A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Applications Handbook 2015, Table 47, Chapter 48 – Noise and Vibration Control.

B. Piping: For piping connected to equipment mounted on vibration control products, install isolation hangers Type N, as indicated, and for first 3 points of support for pipe sizes 4 inches and less, for first 4 points of support for pipe sizes 6 inches through 8 inches, and for first 6 points of support for pipe sizes 10 inches and over.

C. Fan Sets: All fan sets should have thrust restraints when operating over 2 inches W.C. S.P. unless they are mounted on a concrete inertia base in which case the inertia base will not allow fan movement. The fan position at operating and stop positions should not move more than 1/4inch displacement at these two conditions.

3.4 INSTALLATION:

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short- circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

D. Install inertia base frames on isolator units so that minimum of 1 inch clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.

E. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10 percent of equipment weight.

F. Locate isolation hangers as near overhead support structure as possible.

G. Weld riser isolator units in place as required to prevent displacement from loading and operations.

H. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.5 EXAMINATION OF RELATED WORK:

A. Installer of vibration isolation work shall observe installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish written report to Engineer listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:

1. Equipment installations (performed as work of other sections) on vibration isolators.
2. Piping connections including flexible connections.

3. Ductwork connections including provisions for flexible connections.
4. Passage of piping and ductwork which is to be isolated through walls and floors.

B. Do not start-up equipment until inadequacies have been corrected in manner acceptable to vibration isolation installer.

3.6 ADJUSTING AND CLEANING:

A. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short- circuit unit isolation.

3.7 DEFLECTION MEASUREMENTS:

A. Upon completion of vibration isolation work, prepare report showing measured equipment deflections theoretical floor deflection and isolation efficiency for each major item of equipment.

3.8 DUCT AND PIPE PENETRATIONS

A. Where each duct or pipe passes through a wall, floor or ceiling of a noise-critical space (rated NC 25-35 in section 1.5, those rooms with slab-to-slab acoustical partitions, and mechanical/electrical rooms), there shall be a clear annular space of 1" between the duct and structure. This also includes all penetrations of roofs and walls from exterior mechanical equipment. After all of the ductwork is installed, the Contractor shall check the clearance, pack the voids full depth with mineral fiber batt insulation and caulk both ends with a non-aging, non-hardening sealant backed by a polyethylene foam rod or permanently flexible firestop material. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), place a short stub duct in the wall, pack and caulk around it, and then attach the inlet and outlet ducts to each end.

PART 4 - SCHEDULES

4.1 EQUIPMENT VIBRATION ISOLATION TABLE:

A. The following Base and Isolator Types are for these tables only. Refer to Part 2 and Part 3 for additional information.

B. Rooftop Air Handling Units (RTUs) and Make-Up Air Unit (MAU)

1. The entire equipment cabinet shall be mounted directly on a spring isolated roof curb (Mason Industries Type CMAB or equal). The spring isolators shall have a static deflection of 2" under actual load.
2. Because the unit is sitting on an isolation curb, neoprene pads or mounts are recommended for use with internal compressors and fan sections in lieu of spring isolators on the internal elements. Coordinate internal isolation with the manufacturer's recommendations.

C. Exhaust Fans

1. Exhaust fans shall be isolated from structure via neoprene isolation mounts (Mason Industries Type ND or equal).

2. Ducts shall be connected via flexible connectors.

D. Boilers

1. Boilers shall be isolated from structure via neoprene pads (Mason Industries Type W or equal).
2. Piping shall be connected via flexible connectors.

E. Inline Pumps

1. Inline pumps shall be suspended from spring isolation hangers (Mason Industries Type 30N or equal) having a static deflection of 1" under actual load.
2. Piping shall be connected via flexible connectors.

F. DX Condensing Units

1. Rooftop DX units shall be isolated from structure via neoprene pads (Mason Industries Type W or equal). Units shall be supported off roofing by concrete pavers or suitable concrete blocks.

G. Piping shall be connected via flexible connectors.

Base Type Legend:
A = No base, isolators attached directly to equipment
B = Structural steel rails or base
C = Concrete inertia base
D = Curb-mounted base

Isolator Type Legend:
1 = Pad, rubber or glass fiber
2 = Rubber floor isolator or hanger
3 = Spring floor isolator or hanger
4 = Restrained spring isolator
5 = Thrust restraint

Equipment Type	Slab On Grade			Up To 20-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Pumps						
Close-Coupled, 7-1/2 HP and smaller	N/A	N/A	N/A	C	3	0.75
Close-Coupled, 10 HP and larger	N/A	N/A	N/A	C	3	0.75
Inline, Vertical, 5 thru 25 HP	N/A	N/A	N/A	N/A	N/A	N/A
Inline, Vertical, 30 HP and larger	N/A	N/A	N/A	N/A	N/A	N/A
End Suction & Double-Suction, Split-Case, 40 HP and smaller	N/A	N/A	N/A	C	3	0.75
End Suction & Double-Suction, Split-Case, 50 thru 125 HP	N/A	N/A	N/A	C	3	0.75
End Suction & Double-Suction, Split-Case, 150 HP and larger	N/A	N/A	N/A	C	3	1.50
Packaged Pump Systems	N/A	N/A	N/A	A	3	0.75
Boilers, Gas & Oil-Fired						
Condensing, Floor-Mounted	A	1	0.12	A	1	0.12

Equipment Type	Slab On Grade			Up To 20-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Centrifugal Fan						
22" Diameter and Smaller	B	2	0.25	B	3	0.75
24" Diameter and Larger, 40 HP and smaller, ≤ 300 rpm	B	3	2.50	B	3	3.50
24" Diameter and Larger, 40 HP and smaller, 301-500 rpm	B	3	1.50	B	3	1.50
24" Diameter and Larger, 40 HP and smaller, ≥ 501 rpm	B	3	0.75	B	3	0.75
24" Diameter and Larger, 50 HP and larger, ≤ 300 rpm	N/A	N/A	N/A	C	3	3.50
24" Diameter and Larger, 50 HP and larger, 301-500 rpm	N/A	N/A	N/A	C	3	1.50
24" Diameter and Larger, 50 HP and larger, ≥ 501 rpm	N/A	N/A	N/A	C	3	1.50
Ducted Rotating Equipment						
Small Fans, Fan Powered Boxes, 600 cfm and smaller	A	3	0.50	A	3	0.50
Small Fans, Fan Powered Boxes, 601 cfm and larger	A	3	0.75	A	3	0.75

Equipment Type	20 to 30-FT Floor Span			30 to 40-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Pumps						
Close-Coupled, 7-1/2 HP and smaller	C	3	0.75	C	3	0.75
Close-Coupled, 10 HP and larger	C	3	1.50	C	3	1.50
Inline, Vertical, 5 thru 25 HP	N/A	N/A	N/A	N/A	N/A	N/A
Inline, Vertical, 30 HP and larger	N/A	N/A	N/A	N/A	N/A	N/A
End Suction & Double-Suction, Split-Case, 40 HP and smaller	C	3	1.50	C	3	1.50
End Suction & Double-Suction, Split-Case, 50 thru 125 HP	C	3	1.50	C	3	2.50
End Suction & Double-Suction, Split-Case, 150 HP and larger	C	3	2.50	C	3	3.50
Packaged Pump Systems	A	3	1.50	C	3	2.50
Boilers, Gas & Oil-Fired						
Condensing, Floor-Mounted	A	1	0.12	B	4	0.25
Axial Fans, Plenum Fans, Cabinet Fans, Fan Sections, Centrifugal Inline Fans						
22" Diameter and Smaller	A	3	0.75	C	3	0.75

Equipment Type	20 to 30-FT Floor Span			30 to 40-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
24" Diameter and Larger, 2-inches SP and lower, ≤ 300 rpm	C	3	3.50	C	3	3.50
24" Diameter and Larger, 2-inches SP and lower, 301-500 rpm	C	3	2.50	C	3	2.50
24" Diameter and Larger, 2-inches SP and lower, ≥ 501 rpm	B	3	1.50	B	3	1.50
24" Diameter and Larger, 2.1-inches SP and higher, ≤ 300 rpm	C	3	3.50	C	3	3.50
24" Diameter and Larger, 2.1-inches SP and higher, 301-500 rpm	C	3	2.50	C	3	2.50
24" Diameter and Larger, 2.1-inches SP and higher, ≥ 501 rpm	C	3	1.50	C	3	2.50
Centrifugal Fan						
22" Diameter and Smaller	B	3	0.75	B	3	1.50
24" Diameter and Larger, 40 HP and smaller, ≤ 300 rpm	B	3	3.50	B	3	3.50
24" Diameter and Larger, 40 HP and smaller, 301-500 rpm	B	3	2.50	B	3	2.50
24" Diameter and Larger, 40 HP and smaller, ≥ 501 rpm	B	3	0.75	B	3	1.50
24" Diameter and Larger, 50 HP and larger, ≤ 300 rpm	C	3	3.50	C	3	3.50
24" Diameter and Larger, 50 HP and larger, 301-500 rpm	C	3	2.50	C	3	2.50
24" Diameter and Larger, 50 HP and larger, ≥ 501 rpm	C	3	1.50	C	3	2.50
Ducted Rotating Equipment						
Small Fans, Fan Powered Boxes, 600 cfm and smaller	A	3	0.50	A	3	0.50
Small Fans, Fan Powered Boxes, 601 cfm and larger	A	3	0.75	A	3	0.75

END OF SECTION 230540

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SECTION 230553 - IDENTIFICATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), size of valve, and variations for identification (if any). Only tag valves which are intended for emergency shut-off and similar special uses, such as valve to isolate individual system risers, individual floor branches or building system shut off valves. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

B. Mechanical Identification:

1. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping or to match existing size in existing building, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated comply with ANSI A13.1 for colors or to match existing building standard identification.

2.4 PLASTIC PIPE MARKERS:

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. (52 degrees C.) or greater. Cut length to extend 2inches beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2inch.

D. Large Pipes: For external diameters of 6inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Steel spring or non-metallic fasteners.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2inches wide; full circle at both ends of pipe marker, tape lapped 3inches.
3. Strapped-to-pipe (or insulation) application of semi- rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.5 PLASTIC DUCT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, duct markers.

B. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.

C. Nomenclature: Include the following:

1. Direction of air flow.
2. Duct service (supply, return, exhaust, etc.)

2.6 PLASTIC TAPE:

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2inches wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6inches, 2-1/2inches wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.7 UNDERGROUND-TYPE PLASTIC LINE MARKERS:

A. General: Manufacturer's standard permanent, bright- colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

B. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.8 VALVE TAGS:

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4inch high letters and sequenced valve numbers 1/2inch high, and with 5/32inch hole for fastener.

1. Provide 1-1/2inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), and solid brass S- hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8 inch center hole to allow attachment.

2.9 VALVE SCHEDULE FRAMES:

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with non-glare type sheet glass.

2.10 ENGRAVED PLASTIC-LAMINATE SIGNS:

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and

wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16-inch, except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.11 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large- size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.12 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, scheduled and approved by the Owner/Engineer. Provide numbers, lettering and wording as indicated and approved by the Owner/Engineer for proper identification and operation/ maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as designated on the drawings or schedule as well as service.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION:

A. General: Identify air supply, return, exhaust, intake and relief ductwork and duct access doors with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color). Existing building identification shall match the method which exists in the building.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment), other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION:

A. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow. Existing building identification shall match the existing method which exists in the building.

B. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non- insulated pipes.

C. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

D. Near each valve and control device.

E. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

F. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

G. At access doors, manholes and similar access points which permit view of concealed piping.

H. Near major equipment items and other points of origination and termination.

I. Spaced intermediately at maximum spacing of 25 feet along each piping run, except reduce spacing to 15' in congested areas of piping and equipment.

J. On piping above removable acoustical ceilings.

3.4 UNDERGROUND PIPING IDENTIFICATION:

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground- type plastic line marker, located directly over buried line at 6 inches to 8 inches below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.5 VALVE IDENTIFICATION:

A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.

1. Building services main shut-off valves.

2. Each individual system main shut-off valves.
3. Each individual system riser shut-off valves.
4. Each individual system floor shut-off valves.
5. Each individual system major branch shut-off valves.

B. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.

C. Where more than one major mechanical equipment room is shown for project, install mounted valve schedule in each major mechanical equipment room, and repeat only main valves which are to be operated in conjunction with operations of more than single mechanical equipment room.

3.6 MECHANICAL EQUIPMENT IDENTIFICATION:

A. General: Install minimum 2 inch x 4 inch engraved plastic laminate equipment marker on each individual items of mechanical equipment. Provide marker for the following general categories of equipment.

1. Main building systems control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Room thermostats, except gun tag labels are acceptable for room thermostats.
3. Fuel-burning units including boilers, furnaces, heaters, stills and absorption chillers.
4. Pumps, compressors, chillers, condensers and similar motor-driven units.
5. Heat exchangers, cooling towers, heat recovery units and similar equipment.
6. Fans and blowers.
7. Air terminal units.
8. Tanks and pressure vessels.
9. Water treatment systems and similar equipment.

B. Lettering Size: Minimum 1/4 inch high lettering for name of unit.

C. Text of Signs: In addition to the identified unit, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

D. Hand-Lettered Equipment Identification Option: If proposed to and accepted by the Owner in writing, the Contractor shall have the option of providing hand-lettered equipment identification above accessible ceilings for the following equipment:

1. Air Terminal Units: Identification shall be provided on left and right sides and on the bottom of the unit. Letters shall be clear and concise, minimum 1” high, in color contrasting with that of the unit.

3.7 ADJUSTING AND CLEANING:

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 230553

SECTION 230593- TESTING, ADJUSTING AND BALANCING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This section covers testing and balancing of environmental systems described herein and specified under Division 23. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting firm.

1. Test, adjust and balance the following mechanical systems and the mechanical equipment associated with these systems:

a. General Systems and Equipment Procedures.
b. Air Side Systems and Equipment

1) Supply/Return Air Systems
2) Air Handling Units
3) Cabinet/Unit Heaters

c. Hydronic Systems and Equipment

1) Heating water systems
2) Hydronic coils

d. Electrical Components

1) Manual and magnetic starters
2) Variable frequency drives

e. Control Systems and Equipment

1) General

1.2 QUALIFICATIONS OF CONTRACTOR:

A. The Mechanical Contractor shall procure the services of an independent testing and balancing agency specializing in the testing, adjusting and balancing of environmental systems to perform the above mentioned work. An independent contractor is defined as an organization that is not engaged in engineering design or is not a division of a mechanical contractor entity, which installs mechanical systems.

B. The actual fieldwork shall be performed by qualified technicians who are currently certified by the Testing, Adjusting and Balancing Bureau (TABB), the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC) certification agencies.

C. The Testing & Balancing Contractor shall have a minimum of three years experience in testing and balancing mechanical systems.

1.3 APPROVAL OF CONTRACTOR:

A. The following firms are preferred contractors to complete the work. Any Testing and Balancing firm desiring to offer their services for this work and who are not listed below, shall submit their qualifications to the Architect //OR Engineer, not less than [seven (7)] working days before the bid date. Approval or disapproval will be given on each request and this action will be given in writing prior to bidding the work.

1. JPG Engineering

B. Firms who are not listed, or who have not received prior approval shall not be approved to complete work on this project.

1.4 CODES AND STANDARDS:

A. ASHRAE: ASHRAE Handbook, Applications Volume, Testing, Adjusting, and Balancing Chapter.

B. NEBB: “Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.”

C. SMACNA: “HVAC Systems-Testing, Adjusting & Balancing.”

1.5 PRELIMINARY SUBMITTALS:

A. Within ten (10) days of award of the contract the Mechanical Contractor shall submit the name of the Test and Balance Contractor who will be performing the work. The submittal shall include a complete list of all technicians who will be performing the field work and include a photocopy of their current certification by either NEBB, AABC, or TABB certification agencies. Only those technicians included in the submittal shall perform the work. Any personnel or staff used to perform the work without prior approval of the Engineer, who are not included in the submittal, shall be grounds for rejecting the test and balance report and the project in whole.

B. Meet all requirements of Section 23 05 00 “Common Work Results for Mechanical” as applicable.

C. Submit a list of all instrumentation to be used on an individual project and include calibration dates. Submit calibration curves. If more than one instrument of a similar type is used, a comparison of individual readings should be made. The variation between instrument readings should not exceed plus or minus 5%.

1.6 FINAL REPORTS:

A. Refer to Division 1 for supplemental requirements.

B. The Testing and Balancing Contractor shall submit six (6) bound copies of the final testing and balancing report at least fifteen (15) calendar days prior to substantial completion, unless noted otherwise in Division 1. Report contents shall be per Part 3 of this Section.

C. Meet all requirements of Section 23 05 00 “Common Work Results for Mechanical” as applicable.

D. If more than two reports are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

1.7 SEQUENCING AND SCHEDULING:

A. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.

B. Prepare a project schedule. Schedule shall indicate critical path of the balancing process and shall incorporate both requirements of other contractors necessary to meet test and balance commitments and process flow of test and balance work. Coordinate with general and mechanical contractors and insert critical steps into project master schedule.

PART 2 - PRODUCTS

2.1 BELTS, SHEAVES, IMPELLERS:

A. Refer to specific equipment sections and Section 23 05 00 “Common Work Results for Mechanical” for additional requirements.

B. The Testing & Balancing Contractor shall coordinate with the Mechanical Contractor to supply correctly sized drive belts and sheaves. Impellers shall be trimmed or replaced by the mechanical contractor and shall be correctly re-sized and coordinated by the Test and Balancing Contractor per the hydronic systems and equipment portion of this section.

C. The Test & Balance Contractor shall determine the fan belt and sheave replacement necessary for final balance condition for specified air quantity when the VFD is operating in the by-pass mode for final field conditions, without placing the motor over its nameplate amp rating.

PART 3 - EXECUTION

3.1 GENERAL SYSTEM AND EQUIPMENT PROCEDURES:

A. Balance all air and water flows at terminals within +10% to -5% of design flow quantities. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.

B. Pressure relationships indicated on drawings shall take priority over air quantities.

C. Mark equipment settings with paint, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.

D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommend by the original installer.

E. Measure, adjust and report equipment running motor amps and power factor, KW, rated motor amperage, listed motor power factor, voltage, and all nameplate data. Perform these measurements for all equipment operational modes.

F. Check and adjust equipment belt tensioning.

G. Check keyway and setscrew tightness. Report any loose screws and notify Mechanical Contractor prior to equipment balancing.

H. Record and include in report all equipment nameplate data.

I. Verify that all equipment safety and operating controls are in place, tested, adjusted and set prior to balancing.

J. Verify that manufacturer start-up has occurred per specification prior to balancing.

3.2 AIR SIDE SYSTEMS AND EQUIPMENT PROCEDURES:

A. In addition to the procedures identified under each specific heading below, provide general data required by 3.3 above.

B. Filters shall be restricted to increase pressure drop to 50% of span between initial pressure drop and final recommended pressure drop for setting final airflows for fans. Check fan motor amps with clean filters and simulated loaded filters, and report for each piece of equipment. Equipment shall be supplied with clean filters upon completion of balance. Balance and report air quantities.

C. Supply/Return Air Systems:

1. Balance and report supply and return diffuser/grille quantities. Air diffusion patterns shall be set as noted on drawings and to minimize objectionable drafts and noise.
2. Provide full pitot traverses in duct mains downstream of supply fans, upstream of return fans, and in each zone duct downstream of a multizone unit. For VAV systems perform these at the system diversity condition (if any). Balance and report air quantities.
3. Provide full pitot traverses at each air terminal or duct coil. For VAV systems, perform these at zone maximum air condition. Balance and report air quantities.
4. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.
5. Balance and report the above measurements in all system operational/modes.

    a. Minimum outside air and 100% outside air economizer mode.
    b. VAV maximum zone air condition and system diversity condition.
    c. Unoccupied mode.
    d. Two-speed fan, both speeds.
    e. VFD bypass mode and full system demand.

D. General Exhaust/Supply Fans:

1. Adjust CFM to system requirements. For belt drive include sheave and belt exchange to deliver airflow within limits of installed motor horsepower and mechanical stress limits of the fan. Determine the limiting fan tip speed before increasing RPM. Final fan speed setting shall allow for filter loading (as applicable) and shall establish proper duct pressures for operation of zone CFM regulators. For direct drive with speed taps: Set fan speed on tap which most closely approaches design CFM by adjusting the speed control

After adjustment, check fans ability to re-start after powering down. Increase setting if required for proper starting.

2. Measure and report static pressures upstream and downstream of all fans.
3. Measure and report fan RPM.
4. Report design fan inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice.

E. Air Handling Units:

1. On outdoor units, verify that positively or negatively pressurized curbs are free of leaks. Report.
2. For units with integral outside air intake and relief dampers, measure, adjust, set and report outside air, return air and relief air quantities. Perform this as specified under supply air systems.
3. Balance and report supply and return fan CFM, upstream static pressure and downstream static pressure.
4. Measure and report static pressure upstream and downstream of all AHU components such as coils, filters (clean and simulated dirty), dampers, etc.
5. After system and fan balance is complete, perform pitot traverses on all coils in 100% heating and cooling modes.
6. Units with economizers shall have all measurements performed and reported at minimum outside air, 100% outside air, and a 50/50% mixed air condition.
7. Units with operation modes for smoke evacuation and/or pressurization shall have all measurements performed and reported for all modes.
8. Balance variable air volume AHU fans for system design diversity. Supply and return fan static pressures shall be optimized for VAV system terminal device pressure requirements. Report fan, motor and VFD information as previously indicated. Verify that an overload condition does not exist when all system VAV boxes are 100% open.
9. Balance all air handling unit coils and report per hydronic, gas fired, steam or refrigeration equipment portions of this section.
10. Report design fan inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice.
11. Balance and report all temperatures of airside and hydronics during normal operating modes.
12. Measure, adjust, set, balance and report outside air, return air and exhaust/relief air quantities for all air handling systems.

    a. Air quantities shall be determined by pitot traverse/direct airflow measuring procedures where ever possible, where duct/inlet conditions do not allow for accurate direct measurement of outside air the following method shall be used:

    $$\text{Outside Air CFM} = \begin{array}{r}\text{Supply Fan Total CFM} \\ \underline{- \text{Return Fan Total CFM}}\end{array}$$

    b. In addition to the direct measuring of airflow quantities, measure and record outside air, return air and mixed air temperatures, determine thermal/mass energy balance and provide calculations to verify measured airflow quantities. Adjusting and setting the outside air quantity as a percentage of damper position will not be acceptable.

F. General Exhaust Systems:

1. Balance and report exhaust grille quantities. Report objectionable noise.
2. Provide full pitot traverses at each individual exhaust riser and at each exhaust fan. Balance and report.

3. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.

G. Cabinet/Unit Heaters:

1. Balance and report entering and leaving air temperature. Report airflow.
2. Balance all coils per hydronic, gas fired or steam equipment portions of this section.

3.3 HYDRONIC SYSTEMS AND EQUIPMENT:

A. Heating water systems:

1. Hydronic Systems with Meters: The system shall be balanced proportionally using the flow meters. On completion of the balance, the following information shall be recorded in the report: Flow meter size and brand, required flow rate and pressure drop, valve settings on meters with a readable scale, flow rate in both full coil flow and full bypass modes. Contractor shall verify the meters are installed per the manufacturer's recommendations and shall notify the Mechanical Contractor of any deficiencies before utilizing meter.
2. Hydronic Systems without Meters (thermal or terminal rated pressure drop balance): The system shall be balanced proportionally to the terminal ratings. On completion of the balance the following information shall be recorded in the report: Design entering and leaving water temperature/pressure, final balanced entering and leaving water temperature/pressure drop.
3. For 3-way valve terminals/heat exchangers, set bypass flow to equal coil flow.
4. For primary/secondary systems, set crossover/bridle to have constant flow at all conditions.
5. Sample chilled and heating water and report on freeze and burst temperatures of the glycol water solution. Report glycol percentage.
6. Perform similar operations for Hydronic heat reclaim systems.

B. Hydronic Coils:

1. Balance, measure and report inlet and outlet air temperatures for cooling and/or heating design air quantities.
2. Balance, measure and report coil water flow, inlet and outlet water pressure and temperature.
3. Evaporative cooling coils: Measure and report inlet and outlet wet bulb and dry bulb temperature. Measure and report inlet and outlet pressure.
4. Calculate and report face velocities across chilled water and evaporative cooling coils.

3.4 ELECTRICAL COMPONENTS ASSOCIATED WITH MECHANICAL SYSTEMS:

A. Manual and Magnetic Starters:

1. Check all new and existing thermal overloads. Identify improperly protected equipment in report. Furnish and exchange thermals as required for proper motor protection.
2. Motor Control Center Magnetic Starters: Check for correct sizing. Notify Electrical Contractor of discrepancies.
3. Two-speed Starters: In addition to the above, set time delay between changes of speeds for proper operation.

a. Verify windings of motor and starter is compatible prior to starting any equipment.

B. Variable frequency drives.

1. Coordinate balance process with equipment manufacturer start-up representative.
2. Record nameplate data.
3. Record motor overload setting.
4. Record full load amps.

3.5 CONTROL SYSTEMS AND EQUIPMENT:

A. General:

1. Operate all temperature control systems with the temperature control contractor's representative for proper sequence of operation. Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air system flow measurement stations including VAV terminals shall be calibrated against a Pitot tube traverse or air diffuser capture hood. Balancing Contractor shall assure accuracy of all flow measurement devices or shall report their failure to be accurate.
2. Work with the Controls Contractor to set minimum outside air damper positions.
3. Work with the Controls Contractor to optimize VAV duct static pressure, VFD pump hydronic system pressure differential and building pressure.

3.6 SOUND AND VIBRATION:

A. Sound Inspection and Testing:

1. Prior to sound testing, all equipment that can potentially impact sound testing shall be put into operation. Examples include fan coil units, humidifiers, air handling units, and equipment in adjacent mechanical spaces. VFD systems shall be placed at 80% of full speed.
2. Prior to sound testing the mechanical test and balance of all systems shall be completed.
3. Report audible tonal characteristics such as whine, whistle, hum or rumble. Also report time varying sound levels or beats induced from aerodynamic instability, perform this for all rooms.

B. Vibration Inspection and Testing:

1. Prior to vibration testing, all equipment shall be put into operation. On variable speed equipment, testing shall occur at low, medium and high speeds.
2. Prior to vibration testing, the mechanical test and balance of all systems shall be completed.
3. Report excessive vibrations from any equipment. Inspect upstream and downstream duct and piping systems and report excessive vibrations.

3.7 REPORT OF WORK:

A. The Testing and Balancing Contractor shall submit six (6) bound copies of the final testing and balancing report at least fifteen (15) calendar days prior to the Mechanical Contractor's request for final inspection.

B. A complete reduced set of mechanical contract drawings (showing each system) shall be included in the report with all equipment, flow measuring devices, terminals (outlets, inlets, coils, fan coil units, schedules, etc.) clearly marked and all equipment designated. The test and

balance contractor can obtain drawing files from Cator, Ruma, & Associates for development of these drawings.

C. Data shall be reported per Part 3 of this Section on standard NEBB forms. Generate custom forms that contain the information in this Section when a standard NEBB form does not exist for a piece of equipment. All NEBB forms shall be fully filled out for this report. When additional information is required by this Section, it shall be provided. Report forms with design columns filled out shall be used from the Preliminary Systematic Procedure report submitted previously.

D. The report shall include a list of all equipment used in the testing and balancing work.

E. Report systems for excessive sound and vibration per the sound and vibration inspection and testing portions of this specification.

F. Substantial completion of this project will not take place until a satisfactory report is received. The Testing & Balancing Contractor shall respond and correct all deficiencies within seven (7) days of receiving the Engineer's written review of the balancing report. Failure to comply will result in holding retainage of the final payment until all items have been corrected to the satisfaction of the Engineer.

G. The report shall be signed by the supervising registered professional engineer and affixed with their registration stamp, signed and dated in accordance with state law.

3.8 GUARANTEE OF WORK:

A. The Testing & Balancing Contractor shall guarantee the accuracy of the tests and balance for a period of 90 days from date of final acceptance of the test and balance report. During this period, the Testing & Balancing Contractor shall make personnel available at no cost to the Owner to correct deficiencies that may become apparent in the system balance.

END OF SECTION 230593

SECTION 230700- INSULATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc. label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

D. Definitions

1. ASJ: All Surface Jacket.
2. FSK: Foil Scrim Kraft.
3. MRT: Mean Temperature Rating.
4. NRTL: Nationally Recognized Testing Laboratory
5. PCF: Pounds per Cubic Foot.
6. PSF: Pounds per Square Foot.

E. Codes and Standards:

1. International Energy Conservation Code, currently adopted version.
2. ASHRAE 90.1, latest edition.

1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Submit detail product information and installation information for all jacketing systems specified in this section.

1.3 DELIVERY, STORAGE, AND HANDLING:

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

1. Mechanical Insulation:

   a. Johns Manville Corp.

2. Jacketing & Covering Products:

   a. Childers
   b. Ceel-Co
   c. Zeston
   d. Alpha Associates, Inc.
   e. Venture Tape
   f. Polyguard

3. Sound Lagging/Insulation

   a. Soundseal
   b. Vibro-Acoustics
   c. Johns Manville
   d. Owens-Corning
   e. Certainteed

2.2 PIPING INSULATION MATERIALS:

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint. “K” factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.

B. Jackets for Piping Insulation: ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

1. Fitting Covers: UV resistant PVC, pre-molded fitting covers, flame spread 25, smoke developed 50. PVC tape for cold systems, serrated tacks or PVC tape for hot systems.

C. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

D. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated and additional finishes as specified.

2.3 DUCTWORK INSULATION MATERIALS:

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1, 450°F temperature limit, density of 3 PCF. "K" value shall be maximum 0.23 at 75°F mean temperature, vapor transmission rating shall not exceed 0.02 perms, FSK facing.

B. Round Surface Semi-Rigid Fiberglass Blanket Insulation: ATSM C 612, Class 1, 450°F temperature limit, 2.5 PCF density “K” value of 0.25 max at 75°F mean temp, FSK facing. Orientation of fibers shall be perpendicular to facing to facilitate application on round surfaces.

C. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, 3/4 lbs per cu. ft. density. "K" value shall be maximum 0.25 at 75°F mean temperature, 250°F temperature limit, vapor transmission rating shall not exceed 0.02 perms, FSK facing.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.4 SOUND LAGGING/INSULATION:

A. Flexible Fiberglass & Vinyl Sound Insulation: 2.0 PSF, 0.090 inch thick Mylar feed vinyl loaded barrier, tested to 400psi tensile strength. Absorber material, foil covered fiberglass laminated on vinyl barrier, 0.40 PSF, 1 inch nominal thickness insulating value of R-8.0. Assembly flame/smoke index of 12.5/19.5 tested per Class A ASTM E-84. Assembly sound tested per ASTM E-90 for a 5TI of 30 or greater. Rated for temperature between -20°F & 350°F. Provide Soundseal B-20 LAG/QFA-3 or approved equal.

Sound Transmission Loss (dB) Frequency (Hz)							
Product	125	250	500	1000	2000	4000	STC
B-10 LAG / QFA-9	19	20	23	33	44	53	30

B. Sound Lagging Foil Tape: 4” x 200’ rolls of matching foil tape by Soundseal.

C. Insulation for application over duct, piping & equipment.

PART 3 - EXECUTION

3.1 MINIMUM INSULATION REQUIREMENTS

A. All mechanical systems shall be insulated in accordance with the locally adopted energy codes or the requirements of this specification section, whichever is more stringent.

3.2 GENERAL:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.

C. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

3.3 PLUMBING PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, fire protection piping, and pre-insulated equipment.

B. Cold Piping for Condensation Control:

1. Application Requirements: Insulate the following cold plumbing piping systems:

a. Potable and non-potable cold water piping.
b. Interior above-ground horizontal storm water piping including elbow up & down.
c. Roof drain bowls and roof drain leader to horizontal piping.
d. Overflow roof drain bowls and first 10 feet of overflow piping.

2. Insulate each piping system specified above with the following types and thicknesses of insulation:

a. Above Ground, Inside Building, Fiberglass; 1/2 inch thick.

C. Cold Piping for Thermal Control (40-60°F)

1. Insulate each piping system specified above with the following types and thicknesses of insulation:

a. Above Ground, Inside Building, Fiberglass:
1) 1/2 inch thick insulation on pipe sizes 1-1/4 inch and smaller.
2) 1 inch thick insulation on pipe sizes 1-1/2 inch and larger.

D. Hot Piping:

1. Application Requirements: Insulate the following plumbing piping systems:

Potable hot water supply and recirculating piping (105 to 140°F)

2. Insulate each piping system specified above with the following types and thicknesses of insulation:

a. Above Ground, Inside Building, Fiberglass:
1) 1 inch thick insulation on pipe sizes 1-1/4 inch and smaller.

2) 1.5 inch thick insulation on pipe sizes 1-1/2 inch and larger.

b. Below Ground, Flexible Elastomeric:
1) 1 inch thick insulation on pipe sizes 1-1/4 inch and smaller.
2) 1.5 inch thick insulation on pipe sizes 1-1/2 inch and larger.

E. Hot Piping:

1. Application Requirements: Insulate the following plumbing piping systems:

a. Potable hot water supply and recirculating piping (141-180°F).

2. Insulate each piping system specified above with the following types and thicknesses of insulation:

a. Above Ground, Inside Building, Fiberglass:
1) 1.5 inch thick insulation on pipe sizes 1-1/4 inch and smaller.
2) 2 inch thick insulation on pipe sizes 1-1/2 inch and larger.

F. Sound Insulation: Insulate as shown on drawings. Provide 2 inch thick flexible fiberglass/vinyl sound insulation. Install with foil tape at all seams. Provide plastic wire ties every 18 inches around piping to fully fasten insulation to piping. Obtain a copy of manufacturer's installation requirements, keep copy on site, and follow all instructions.

3.4 HVAC PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on steam condensate piping between steam trap and union; and on hot piping unions, flexible connections, and expansion joints. Insulation may be omitted inside of cabinet unit heaters, convectors and fan coils for hot piping. Cold piping insulation inside fan coil unit cabinet may be omitted provided piping is located over drain pan. Hot and cold piping routed inside air handler units shall be insulated. Omit insulation on strainers in heating water strainers operating below 200°F.

B. Cold Piping (40 to 60°F):

1. Application Requirements: Insulate the following piping systems:

a. Chilled water supply and return piping.
b. Cold condensate drain piping.
c. Condenser water supply and return piping when used with plate and frame or cooling coil applications.
d. Process chilled water supply and return piping.

C. Heating System Piping (105 to 200°F):

1. Application Requirements: Insulate the following piping systems:

a. Hot water supply and return piping.

2. Insulate each piping system specified above with the following type and thicknesses of insulation:

a. Above Ground, Inside Building, Fiberglass:
1) 1.5 inch thick insulation on pipe sizes 1-1/4 inch and smaller.

2) 2 inch thick insulation on pipe sizes 1-1/2 inch and larger.

3.5 DUCTWORK SYSTEM INSULATION:

A. Insulation Omitted: Do not insulate fibrous glass ductwork, or lined ductwork.

B. Application Requirements: Insulate the following ductwork and equipment:

1. Outdoor air intake ductwork and plenums between air entrance and fan inlet or HVAC unit inlet.
2. Mixed air ductwork and plenums between air entrance and fan inlet or HVAC unit inlet.
3. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet unless ductwork is specified to be lined.
4. HVAC return ductwork in unconditioned spaces or exterior; except omit insulation when ductwork is specified to be lined.
5. HVAC plenums and unit housings not pre-insulated at factory or lined.
6. Rigid oval or round supply air ductwork.
7. Induced draft fan scrolls.

C. Insulate each ductwork system specified above with the following types and thicknesses of insulation:

APPLICATION	TYPE, THICKNESS		
	RIGID FIBERGLASS	FLEXIBLE FIBERGLASS	FLEXIBLE ELASTOMERIC
Interior; concealed; cold, hot or dual temperature duct	1-1/2" minimum up to 2” as required to cover joints & reinforcements	1-1/2"	2”
Interior; exposed within conditioned finished spaces; cold, hot, or dual temperature duct	None	None	None
Interior; exposed within mechanical, storage, or other service areas; cold, hot, or dual temperature duct	1-1/2" minimum up to 2" as required to cover joints and reinforcements	Not Allowed	2". Provide white finish coat.
Exterior; hot, cold or dual temperature duct, all return duct	Not Allowed	Not Allowed	Minimum 2-1/2”

3.6 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on cold pipe insulation, and protect to prevent puncture or other damage.

1. Do not use staples or tacks on vapor barrier jackets.
2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
3. Seal fitting covers with PVC tape.
4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identify item covered.

F. Neatly bevel and seal insulation at all exposed edges.

G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

I. See equipment insulation for removable insulation on accessible piping components.

J. See Section 23 05 29 for insulation inserts and shields. Butt pipe insulation against pipe hanger insulation inserts. For all piping apply wet coat of vapor barrier lap cement on butt joints and seal all joints and seams with 3 inch wide vapor barrier tape or band.

3.7 INSTALLATION OF DUCTWORK INSULATION:

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

1. Avoid the use of staples on vapor barrier jackets.
2. Seal vapor barrier penetrations with vapor barrier tape recommended by the manufacturer.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed. Sound attenuators do not qualify for this omission.

G. Flexible Fiberglass Insulation: Cut back insulation to provide a 2 inch facing overlap at all seams. Seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with pressure-sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18inches on center. The protruding

ends of the fasteners should be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above.

H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on all external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

I. Adhere flexible elastomeric sheets to clean oil-free metal surface by compression fit method and full coverage of adhesive. Seal butt joints with same adhesive. For exterior ductwork, notch insulation at reinforcements and joint flanges to provide a smooth surface, unless the reinforcements or joints would penetrate the insulation. Provide a minimum ½ inch cap over any penetrating item. Stagger all joints and seams on multi-layer insulation.

J. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing aluminum or self-adhesive laminate jacketing.

1. Fabricate rectangular ductwork to have a minimum 1/2” per foot slope on the top surface, and/or slope insulation to prevent ponding.
2. Aluminum jacketing shall be secured by 1/2 inch wide stainless steel bands located on 24 inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose pre-fabricated sealing and fastening systems, submit samples and product data for approval.

3.8 EXISTING INSULATION REPAIR:

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.

3.9 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230700

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SECTION 230900- INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The Control Contractor will be responsible for all installation, programming, commissioning, testing and performance verification.

B. The Controls Contractor will be responsible for providing all devices required for a complete operating control system.

C. It shall be a digital, distributed microprocessor-based system with an electronic interface, where required. The Control System for this project will be referred to as a Building Automation System (BAS).

D. Total quantity and type of control points shall consist of specifications, drawings and as required to complete the sequence of operation as specified. Additional points shall be provided as required to meet all sequence of operation functions, safeties and data base. The drawings and Specifications are not intended to show all details necessary to make the system complete and operable.

E. The Control Contractor shall be responsible for all phases of software design, all equipment, installation and warranty for the BAS. The Control Contractor shall be responsible for supplying and installing all necessary control devices for completing the BAS.

F. The system shall include all control device, valves, interlocks, field devices, hardware, software, automatic dampers, piping, fittings, wire, conduit, etc., as specified and required and connected so as to perform all functions and operate according to the specified sequences.

G. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner or Architect/Engineer in writing. Unless approved otherwise, all products (including firmware revisions) used in this installation shall have been used in at least twelve (12) projects prior to this installation. The previous sites may be located anywhere in the U.S.A. This requirement is not intended to restrict the Contractor to the use of any outdated equipment. Therefore, all products used in this installation shall also be currently under manufacture and have available, for at least ten years after completion of the contract, a complete line of spare parts. If the above requirements are mutually exclusive, the Contractor shall include a specific statement to this effect in the Bid.

H. Refer to other Division 23 sections for installation of instrument wells, valve bodies and dampers in mechanical systems.

I. Provide electrical work as required, complying with requirements of Division 26 sections including, but not limited to raceways, wires, cables, electrical identification, supporting devices and electrical connections for equipment. Work includes, but is not limited to, the following:

1. Interlock and control wiring between field-installed controls, indicating devices and unit control panels.
2. The Contractor shall be responsible for all additional electrical and other costs involved to accommodate the temperature control system panel, motors and electrical devices

requiring power which differs from the power requirements shown on the electrical drawings.

3. Refer to Division 26 for mechanical/electrical coordination.

J. Control Contractor shall furnish & identify location requirements for all necessary control devices which may be installed by others including the following, but not limited to:

1. Automatic control valves.
2. Flow switches.
3. Outside, return and exhaust air dampers for the supply fan/return fan systems.
4. Modulating dampers.
5. Required wells for insertion thermostats and/or temperature sensing wells.
6. Pressure Sensors.

1.2 QUALITY ASSURANCE:

A. Contractors Qualifications: Firms regularly engaged in installation and commissioning and servicing of digital control equipment, of types and sizes required, whose firm has been in business in similar service for not less than 5 years.

B. All work of this Section shall be fully “Year 2000 Compliant”. See Section 23 05 00 “Common Work Results for Mechanical”. All date related data shall use four digit dates. “Windowing” of dates is specifically prohibited.

C. Only those manufacturers specified are allowed to bid temperature controls. All bidders shall make available, upon the Owner's request, open book unit pricing of all materials and labor.

D. The system shall be installed by competent mechanics, regularly employed by the Temperature Control Contractor.

E. All bidders must have installed and completed at least two (2) direct digital temperature control jobs of similar design, size and scope using the same equipment as specified.

F. All bidders must have a local office in the area of the project site.

G. All bidders must have capabilities of doing component level repairs on all systems, including electronic systems.

H. No Field Devices shall be multiplexed to a single I/O point unless specified. Each control or sensing point shall be terminated at a unique location on the BAS panel, Slave or Dedicated Controller and be associated with a unique software point on the BAS.

I. Codes and Standards:

1. All equipment and the installation shall comply with the requirements of all applicable local and national codes including but not limited to the currently enforced edition of the International Building, International Fire, International Mechanical and all applicable codes of the National Fire Protection Association including the National Electrical Code.
2. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by UL and comply with NEMA standards.
3. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

4. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

J. All bidders must have a minimum of one person dedicated to software generation. This person shall be located in an office local to the project site.

K. The equipment and software proposed by the supplier shall be currently in manufacture. No custom products shall be allowed unless required by the Specification. All products shall be supported by the manufacturer for a minimum of 5 years including spare parts, board repairs and software revisions.

L. The Temperature Control Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others work.

M. It will be the responsibility of the Contractor to work in cooperation with the Owner and with all other contractors and employees rendering such assistance and so arrange his work such that the entire project will be delivered complete in the best possible condition and in the shortest time.

1.3 PROPRIETARY INFORMATION:

A. Project Documentation: All custom software, programs, code, databases, graphic files and drawings (whether hard copy or CADD based files) prepared for this system shall be the exclusive property of the Owner and shall not be reproduced or distributed without prior written permission from the Owner.

B. The use or reference to the Owner or any of its subsidiaries or any of the facility automation projects shall not be used by the Manufacturer or Contractor in any promotional media, including advertisements, sale brochures, annual reports and client references or endorsements, without prior written permission from the Owner. The Owner reserves the right to restrict or refuse access to any or all of its facilities.

1.4 SUBMITTALS:

A. Submit in accordance with Division 1 and 23 submittal requirements.

B. In addition to the requirements set forth in paragraph A above, the following shall be included in the shop drawing submittals including, but not limited to:

1. Product Data: Submit manufacturer's technical product data sheets for each control device furnished, each data sheet shall be labeled indicating its control drawing descriptor and include the following:

a. indicating dimensions;
b. capacities;
c. performance characteristics;
d. electrical characteristics;
e. finishes of materials;
f. commissioning, installation instructions and start-up instructions.

2. Valve, damper and well and tap schedule showing size, configuration, capacity and location of all equipment.
3. Control system drawings containing pertinent data to provide a functional operating system and a sequence of operation.
4. Detailed wiring diagrams.
5. A floor plan of each area with a detailed new conduit/wiring layout shall be included. The plan shall indicate all conduit locations within ±2' of actual installed location. All walls, doors and temperature control devices shall be accurately shown.
6. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and all control devices. Identify all control points with labeling.
7. Label each control device with setpoint or adjustable range of control. Provide a bill of materials with manufacturer's part number.
8. Indicate all required point to point electrical wiring. Clearly differentiate between portions of wiring that are existing and portions to be field-installed.
9. Provide details of faces of control panels, including controls, instruments, and labeling.
10. Include verbal description of sequence of operation and reference each device described by schematic symbol used.
11. Provide a detailed listing of all software program code written for each system.
12. Provide a point list with database input information to include a point name, address, base and span, action and other required information.
13. Provide a detailed test plan and procedure for each HVAC system and for each type of terminal unit control including valves. The test plans shall fully define reporting methods, procedure, equipment utilized, milestones for the tests, identifying the simulation programs, and personnel. The test procedures shall be developed from the test plans and shall consist of instructions for test execution and evaluation. A test report form shall be developed for each point and sequence of operation. Commissioning procedures shall be provided for each HVAC system and for each type of terminal unit control system. The procedure shall include setpoint, prop. band, integral, derivative, mode constraints input, output settings, tuning procedures., etc.

C. Submit manufacturer's installation instructions.

D. Submittal data and shop drawings shall be prepared and submitted in the following formats:

1. All drawings prepared for the project shall be developed using the AutoCAD program, most current version, (or a CADD package capable of producing AutoCAD "DXF" compatible format files).
2. All submittals data shall be the same size for any group of information and shall be in a three screw and post binder. (NO EXCEPTIONS). All the information shall be indexed and tabbed with reference to the specific section of these specifications.
3. The format for different groups of submittal information are as follows:

    a. Control drawings, building plans (including complete floor plans), schematics and system configurations shall be CAD prepared drawing, bound and indexed. Drawings that cannot represent the total information on an individual ANSI size B (11" x 17") drawing, i.e. a building plan, shall be noted with appropriate match lines, cross references and key plans.
    b. Technical data, sequence of operations, material list, point lists, program listings, I/O schedules, operator's and programmer's manuals, etc. shall be type written, original product data sheets or CAD prepared drawings, ANSI size A or ANSI size B.

4. Upon completion of the project and acceptance of systems the contractor shall provide to the Owner one set of hard copy as-built shop drawings and diskettes.

E. Shop drawings shall include riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typicals will be allowed where appropriate.

F. When the Architect/Engineer requires, the Contractor will resubmit with the corrected or additional submittal data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully reviewed.

G. Contractor agrees that shop drawing submittals processed by the Architect/Engineer are not change orders, that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Architect/Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. The Contractor shall be responsible for space requirements, configuration, performance, changes in bases, supports, structural members and openings in structure, and other apparatus that may be affected by their use.

H. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents in the form of design drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the Architect/Engineer, the design drawings and specifications shall control and shall be followed. If alternates do not meet these requirements, it shall be this Contractor's responsibility to remove them and install material originally specified, at no cost to the Owner.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent any equipment damage, and to eliminate all dirt and moisture from equipment. Store all equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND CONTRACTORS:

A. Subject to compliance with requirements, install one of the following systems:

1. Automated Logic

2.2 GENERAL PRODUCTS DESCRIPTION:

A. The Building Automation System (BAS) shall be capable of integrating multiple building function including equipment supervision and control, alarm management, energy management, and historical data collection and archiving. All products and materials installed shall be suitable for the intended application requirements including but not limited to:

1. Accuracy
2. Rangeability
3. Temperature and pressure ranges
4. Shut-off pressures

5. Differential pressures
6. Repeatability
7. Materials of construction suitable with the environment and/or media in which they are in contact with
8. Code compliance
9. Velocities

B. The BAS shall consist of the following:

1. Standalone DDC panels
2. Standalone application specific controllers (ASCs)
3. Portable Operator's Terminals
4. Personal Computer Operator Workstations
5. High Speed Communication Network (LAN)

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, standalone DDC panels, and operator devices.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC panel shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Standalone DDC panels shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC panel or combination of panels on the network without dependence upon a central processing device. Standalone DDC panels shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

F. Shared points will not be allowed.

G. BAS shall allow third party software to operate on personal computer workstation without any degradation to the controls operating normally.

2.3 STANDALONE DDC PANELS:

A. General: Standalone DDC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this specification and the attached point list.

B. Memory: Each DDC panel shall have sufficient memory to support its own operating system and databases including:

1. Control Processes
2. Energy Management Applications
3. Alarm Management
4. Historical/Trend Data for all points
5. Maintenance Support Applications
6. Custom Processes
7. Operator I/O

8. Dial-Up Communications
9. Manual Override Monitoring

C. Point Types: Each DDC panel shall support the following types of point inputs and outputs:

1. Digital Inputs for status/alarm contacts
2. Digital Outputs for on/off equipment control
3. Analog Inputs for temperature, pressure, humidity, flow and position measurements
4. Analog Outputs for valve and damper position control, and capacity control of primary equipment
5. Pulse inputs for pulsed contact monitoring

D. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of software applications, workstation hardware, field controllers, sensors and actuators.

E. The system architecture shall support a minimum spare capacity of 20% for all types of DDC panels, and a minimum of at least two point types included as spare in the initial installation.

F. Serial Communication Ports: Standalone DDC panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as industry standard printers, laptop workstations, PC workstations, and panel mounted or portable DDC panel Operator's Terminals. Standalone DC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or network terminals.

G. Hardware Override Switches: The operator shall have the ability to manually override automatic or centrally executed commands at the DDC panel via local, point discrete, onboard hand/off/auto operator override switches for analog control type points. These override switches shall be operable whether the panel is powered or not.

H. Hardware Override Monitoring: DDC panels shall monitor the status or position of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited. DDC panels shall also collect override activity information for daily and monthly reports.

I. Local Status Indicator Lamps: The DDC panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

J. Integrated On-Line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all subsidiary equipment. The DDC panel shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each DDC panel, and shall not require the connection of an operator I/O device.

K. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with the latest IEEE Standard 587.

1. Provide ISLATROL active tracking filters or equal, which provides both high and low voltage transients, non-linear characteristics, capable of instantaneously responding to spikes or transients without degradation to the filter or its performance. Power protection device shall be UL listed and have reliability in excess of 100,000 hours of mean time between failures.

2. Signal wiring shall not be installed in same conduit as high voltage wiring.

L. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of all standalone DDC panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.
2. Should DDC panel memory be lost for any reason, the user shall have the capability of reloading the DDC panel via the local area network, via the local RS-232C port, or via telephone line dial-in.

2.4 SYSTEM SOFTWARE FEATURES:

A. General

1. All necessary software to form a complete operating system as described in this specification shall be provided.
2. The software programs specified in this section shall be provided as an integral part of the DDC panel and shall not be dependent upon any higher level computer for execution.

B. Control Software Description

1. Pre-Tested Control Algorithms: The DDC panels shall have the ability to perform the following pre-tested control algorithms.

a. Two Position Control
b. Proportional Control
c. Proportional plus Integral Control
d. Proportional, Integral, plus Derivative Control
e. Automatic Control Loop Tuning

2. Equipment Cycling Protection; Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
3. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
4. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

C. Energy Management Applications: DDC panels shall have the ability to perform any or all of the following energy management routines.

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Enthalpy Switchover (Economizer)

9. Peak Demand Limiting
10. Temperature Compensated Load Rolling
11. Fan Speed/CFM Control
12. Heating/Cooling Interlock
13. Hot Water Reset

D. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the Execution portion of this specification.

E. Custom Process Programming Capability: DDC panels shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:

    a. Any system-measured point data or status
    b. Any calculated data
    c. Any results from other processes
    d. User-Defined Constants
    e. Arithmetic functions (+, -, *, /, square root, exp, etc.)
    f. Boolean logic operators (and, or, exclusive or, etc.)
    g. On-delay/Off-delay/One-shot timers.

2. Process Triggers: Custom processes may be triggered based on any combination of the following:

    a. Time interval
    b. Time of day
    c. Date other processes
    d. Time programming
    e. Events (e.g., point alarms)

3. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other DDC panels on the local area network.
4. In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local area network.
5. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution of a dial-up connection to a remote device such as a printer or pager.
6. Custom Process Documentation: The custom control programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphical flowcharts and English language descriptors.

F. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the DDC panel's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network.

1. Point Change Report Description: All alarm or point change reports shall include the point's English language description and the time and date of occurrence.

2. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each DDC panel shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
3. The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.
4. Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices, or PCs used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
5. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 65-character alarm message to more fully describe the alarm condition or direct operator response.
6. Each standalone DDC panel shall be capable of storing a library of a least 250 Alarm Messages. Each message may be assignable to any number of points in the panel.
7. Auto-Dial Alarm Management: In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

G. Historical Data and Trend Analysis: A variety of Historical Data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways.

1. Continuous Point Histories: Standalone DDC panels shall store Point History Files for all analog and binary inputs and outputs.
2. The Point History routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be store for the past 24 hours to allow the user to immediately analyze equipment performance and all problem related events for the past day. Point History files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.
3. Control Loop Performance Trends: Standalone DDC panels shall also provide high resolution sampling capability with an operator-adjustable resolution of 10-300 seconds in one second increments for verification of control loop performance.
4. Extended Sample Period Trends: Measured and calculated analog and binary data shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of one minute to two hours, in one-minute intervals, shall be provided. Each standalone DDC panel shall have a dedicated buffer for trend data, and shall be capable of storing a minimum of 500 data samples.
5. Data Storage and Archiving: Trend data shall be stored at the Standalone DDC panels, and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined interval, manual command, or when the trend buffers become full. All trend data shall be available in disk file form for use in 3rd Party person computer applications.

H. Runtime Totalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Execution portion of this specification.

1. The Totalization routine shall have a sampling resolution of one minute or less.
2. The user shall have the ability to define a warning limit for Runtime Totalization. Unique, user-specified messages shall be generated when the limit is reached.

I. Analog/Pulse Totalization: Standalone DDC panels shall automatically sample, calculate, and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. KWH, gallons, KBTU, tons, etc.).
2. The Totalization routine shall have a sampling resolution of one minute or less.
3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

J. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

1. The Event Totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.
2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

2.5 APPLICATION OF SPECIFIC CONTROLLERS - HVAC APPLICATIONS:

A. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).

B. Each ASC shall operate as a Standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Points shall not be shared between controllers.

C. Each ASC shall have sufficient memory to support its own operating system and data base including:

1. Control Processes
2. Energy Management Applications
3. Operator I/O (Portable Service Terminal)

D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation, or any PC or portable operator's terminal connected to any DDC panel in the network.

E. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include, but not be limited to, the following:

1. Display temperatures
2. Display status
3. Display setpoints
4. Display control parameters
5. Override binary output control
6. Override analog setpoints
7. Modification of gain and offset constants

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.

2.6 AHU CONTROLLERS:

A. AHU Controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in the Execution portion of this specification, and for future expansion.

1. Large Air Handling Units

a. Mixed Air-Single Path

B. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.

C. AHU Controllers shall have a library of control routines and program logic to perform the sequence operation as specified in the Execution portion of this specification.

D. Occupancy-Based Standby/Comfort Mode Control: Each AHU Controller shall have a provision for occupancy sensing overrides. Based upon the contract status of either a manual wall switch or an occupancy sensing device, the AHU Controller shall automatically select either Standby or Comfort mode to minimize the heating and cooling requirements while satisfying comfort conditions.

E. Continuous Zone Temperature Histories: Each AHU Controller shall automatically and continuously maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.

F. Alarm Management: Each AHU Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

2.7 UNINTERRUPTED POWER SUPPLY (UPS):

A. General:

1. Provide one or more Uninterrupted Power Supply (UPS) dedicated to the BAS to accommodate interruptions in building power supply.
2. General Requirements shall include the following:

a. All mechanical equipment which is supplied with emergency power shall have the associated DDC controller supplied with emergency power.
b. UPS shall include LAN port and modem line surge protection.
c. UPS shall be sized to carry the BAS and all connected components at full-load runtime through power outage and activation of generator and automatic transfer switch with a typical runtime of up to 60 minutes.
d. UPS shall provide a minimum 480-joule suppression rating. Suppression response time shall be instantaneous.
e. Batteries supplied shall be of the type not requiring dedicated exhaust ventilation per the Fire Code for this project.

f. UPS shall be capable of hot-swapping batteries while simultaneously providing clean power out to the BAS.
g. Typical recharge time shall be 2-4 hours.
h. Maximum incremental size for a UPS shall be 5000VA. Multiple units shall be required for loads exceeding 5000VA.
i. Setup UPS programming to meet the requirements for all connected components.
j. Provide all software, cables, peripherals, etc., for a complete system.

2.8 MATERIALS AND EQUIPMENT:

A. General: The Contractor shall provide control products in the sizes and capacities indicated. The existing control system shall remain and be reused as is. Additional controllers, sensors, and devices which are required to make a complete control system shall be the responsibility of the controls contractor.

B. Dampers shall be constructed of a minimum of 13 gauge galvanized steel frame, double piece, 22-gauge galvanized steel mechanically joined, zinc plated steel concealed linkage and blade pin, oil impregnated bearings, self-compensating stainless steel side seals and silicone blade seals. Leakage rates shall not exceed 10 cfm/ft^2 at 4" w.c. static pressure differential for a 24" x 24" damper. Provide extended shaft for proper and adequate actuator connection and operation. Damper blades shall not exceed 6" in height.

C. Damper blade operation shall be as follows:

APPLICATION	OPERATION
Modulating Air Volume Control	Opposed Blade
Mixing Plenum	Parallel Blade/Opposed Blade
Isolation/Shut-off Service	Parallel Blade

D. Automatic Control Valves:

1. Control valves shall have equal percentage plugs.
2. Control Valve Construction:

a. Small Valves 1/2" through 1": Valves shall be constructed with a cast brass body and screwed ends. Trim shall consist of a removable cage providing valve plug guiding throughout the entire travel range. A stainless steel stem shall be provided. Bonnet, cage and the stem and plug assembly shall be removable for servicing. Body rating shall be 400 psi at 150 deg. F.
b. Valves - 1/2" through 2": Valves shall be constructed with a cast brass body and screwed ends. For special duty, valves may be selected by the control manufacturer to have either bronze or cast iron bodies with screwed or flanged ends.
c. Valves - 2 - 1/2" and above: Valves shall be constructed with a cast iron body and have flanged connections.
d. For motorized plug, butterfly and ball valves, the operator shall be provided with the valve by the valve manufacturer. See Section 23 05 23.

3. Control Valve Operators/Actuators:

a. All automatic control valves shall be fully proportioning with modulating plugs for equal percentage of linear flow characteristics and shall be provided with actuators of sufficient power for the duty intended. Valve body and actuator selection shall be sufficient to handle system pressure which will be encountered on the project.
b. Where required by the sequence of operation, valves shall be capable of being sequenced either with other valves or other actuated devices. Where such sequencing is required the actual spring range, when adjusted for spring shift, shall be such that no overlapping occurs. In the event that spring shift can cause an overlap, a pilot positioning operator shall be furnished.
c. Actuator housings shall be cast aluminum, with synthetic rubber diaphragm, spring return type.

4. Temperature control contractor and manufacturer shall size control valves for proper control characteristics for each application.
5. Water control valves shall be sized for a pressure drop between 4 to 6 psig at full flow condition.
6. Select valves to fail in normally open or closed position as follows:

a. Terminal Heating Devices:
1) Offices, Patient Care, Hospital, Public Areas and schools

N.O.

2) Research labs, computer equipment rooms, telephone equipment rooms, animal holding rooms, etc.

N.C.

b. Or as dictated by life safety, freeze protection, humidity, fire or temperature protection.

2.9 INPUTS:

A. All input accuracies required by this section shall be end-to-end (from sensing point to BAS display). End-to-end accuracy includes all errors due to the sensor, transmitter, wiring and BAS signal measurement and A/D conversion.

B. Thermistors or solid state sensors shall be provided for temperature sensing applications except where accuracies or ranges required cannot be met by these devices, RTD's shall be used. The sensors shall be powered by the BAS panel or Dedicated Controller. The solid state sensors shall be accurate to within ±0.5deg F. over the following ranges and meet the following requirements:

1. Room Type Instruments: 50deg F to 100deg F. For room space applications: Sensor shall be recessed mounted in a stainless cover with an insulated baseplate & vandalproof screws.

Each thermostat shall have the following features:
a. Concealed setpoint adjustment dial with temperature graduation indication.
b. Exposed graduated temperature indicating thermometer.
c. All/Public area thermostats shall be provided with a plastic/stainless steel vented, lockable security cover.

2. Duct & Plenum Applications: -30deg F. to 240deg F. Supply, return, exhaust or mixed air averaging type, which shall have an extended element of sufficient length to cover the

entire duct cross-section with a minimum of three passes. If a single averaging thermistor of sufficient length to meet the preceding are not available then two or more sensors and AIs shall be used and averaged in software.

3. Water Temperature Applications: 30deg F to 230deg F.

C. Where RTD's are required, they shall be 1000 ohm platinum type and be supplied with a 4-20 mA DC transmitter. The sensor and transmitter shall be a single unit. They shall be accurate to within ±1.0deg F. over the range of 32deg F. to 600deg F.

D. Where thermocouples are required, they shall be type J and be supplied with a 4-20 mA DC transmitter. They shall be accurate to within ±2.0deg F over the range of 32 deg F to 1300 deg F.

E. Provide matched temperature sensors for applications which require both inlet and outlet temperatures of any device.

F. Thermowells shall be monel, brass or copper for use in copper water lines; and 300 series stainless steel for all other applications.

G. Outdoor Air Temperature & Humidity Transmitter:

1. Provide Vaisala HMD60Y0 relative humidity and temperature probe with membrane filters and UV stabilized solar radiation shield. Probe shall have a temperature measuring range of -40deg F. to +120deg F. with an accuracy of ±.54deg F at 68deg F. and relative humidity measuring range of 0 to 100% RH with an accuracy of 2% 0 to 90% RH with a repeatability better than 1% RH per year. RH and temperature probe shall be capable of a continuous temperature operating range of -40deg F. to +120deg F. Provide necessary transmitter for output signals.
2. Provide 1 spare set of protective filters for each transmitter Viasala No. 17039.

H. Humidity Transmitter:

1. Duct humidity transmitters shall be Vaisala Model HMD60U. Transmitters shall measure relative humidity from 0-100% RH with repeatable accuracy of ±2% RH. Long range RH stability shall be better than 1% RH/year. Duct mounting enclosure shall be cast aluminum, NEMA 4. Instruments shall be temperature compensated over entire range of operation. Sensor shall utilize the registered HUMICAP H-sensor. Sensor filter shall be membrane type, 18.5 mm. Provide 4-20 mA output signal to building automation control system.
2. Wall Mounted Humidity Transmitter: Wall mounted humidity transmitter shall be Vaisala Model HMW60U. Transmitter shall measure relative humidity from 0 to 100% RH, ±2% accuracy, wall mounted ABS plastic box, with a long range RH stability better than 1% RH/year and temperature compensated over the entire range. Sensor shall utilize the registered HUMICAP H-sensor. Sensor filter shall be membrane type 18.5 mm and a 4-20 mA output signal.

    a. Provide 1 spare set of filters for each transmitter Viasala No. 17039.

I. Humidity and temperature calibrator kit:

1. Provide Viasala HMK41 Kit for single point calibration of air temperature and humidity transmitters. Kit shall include:

    a. HMI41 Sensor.
    b. HMP46 Probe.

c. N.I.S.T. Certificate.
d. 1911622 Calibration Cable.
e. Carrying Case.

J. Pressure Sensors, Transmitters and Differential Switches:

1. Pump/Liquid (wet) differential pressure switches shall be as manufactured by BARKSDALE with neoprene diaphragm, stainless steel internal parts, NEMA 4 housing.
2. Air Differential Pressure Transmitters shall be Modus model T30 or T40 (as required) with an accuracy of ±1% of range (including nonlinearity and hysteresis), solid state circuitry, no moving parts, capacitance principle capable of sensing positive, negative and differential pressures. Transmitter shall have 4-20 mA output signal and be powered by the control system or dedicated controller and capable of withstanding momentary overpressure of 8 times the pressure range.
3. Differential air pressure switches for filter or proof of airflow status shall be Dwyer Series 1910, with automatic reset, SPDT.
4. Hi-static pressure safety switches shall be Dwyer series 1900 MR, with manual reset, snap switch, SPDT, with repetitive accuracy within 3%.
5. Water/Liquid/Steam/Refrigerant Pressure Transmitter: Kele & Associates Model SA, stainless pressure transmitter with 4-20 mA output signal, watertight enclosure with stainless steel bulkhead fitting, accuracy of ±1% full scale, temperature compensated, 300 series stainless steel wetted parts.

    a. Provide Model 47S pressure snubber for applications where the transmitter is subjected to fluid hammer, pressure surge or pulsation.
    b. Provide Model PT steam syphon pigtail steam applications and where the fluid temperature is higher than the maximum operating temperature rating of the transmitter.

6. Air and Vacuum Pressure Transmitter: Kele & Associates Model P100GTE, solid state, 4-20 mA signal with a full scale accuracy of 1%.

K. Output Devices:

1. Control Relays: Control relay contacts shall be rated for the application, with a minimum of 2 sets of Form C contacts enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage. Provide with LED to indicate status.
2. Analog output transducers shall be of positioning type with position feedback and control internal to the transducer. As an option, position feedback may also be input to the BAS.
3. Analog output transducers shall meet the following requirements:

    a. 4-20 mA DC output.
    b. Two-pipe electromechanical design or microprocessor-based design.
    c. 3-15 psi output range adjustable to a 0-20 psi range minimum.
    d. Linearity, repeatability and hysteresis no greater than 2% of full scale.
    e. Air capacity of 1000 SCIM minimum.
    f. Air consumption of no more than 100 SCIM.
    g. Pressure gauges shall be installed on the branch and supply lines.
    h. Acceptable transducers are the Bellofram T1000, Fairchild T5700, Johnson N6810, Mamac EP-310 or an equivalent.

4. Electronic analog output transducers shall output a signal to match the controlled device. The Contractor shall be responsible for verifying the required signals for all controlled devices. Transducers shall be completely solid-state with no mechanical parts.
5. Time Delay Relays: Time delay relay contacts shall be rated for the application with a minimum of 2 sets of Form C contacts enclosed is a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Relays shall be equipped with coil transient suppression, devices to limit transients to 150% of rated coil voltage. Delayed contact openings or closing shall be adjustable from 1 to 60 seconds with a minimum accuracy of ±2% of setting.
6. Latching Relays: Latching Relay contacts shall be rated for the application with a minimum of 2 sets of Form C contacts enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage.

2.10 GAUGES:

A. General: Provide air pressure gauges for indication of supply and control air pressure at each branch for all control valve sizes 1" and larger, as well as all control dampers, all controllers, relays and EP and PE switches.

B. Air pressure gauges shall be a minimum of 1-1/2" diameter, resistant to effects of shock, pulsation and vibration, with a full scale accuracy of ±2.5%.

C. Round receiver gauges for continuous indication of analog values shall be 4" dial face instruments. Gauges shall be calibrated in appropriate units for the variable being measured and shall operate through their full range on a change in air pressure from 3 to 15 psi. Accuracy shall be plus or minus 1/2% of full scale.

2.11 POSITIONERS:

A. Positive positioning relays shall be provided on valve actuators and damper operators when required to provide sufficient power, sequencing and repeatability.

B. Provide for smooth gradual operation over operating span adjustment of 0 to 15 psi and start point adjustment of 3 to 10 psi.

2.12 CUMULATORS, SWITCHES AND MISCELLANEOUS ITEMS:

A. Provide all cumulators, switches and other miscellaneous items as may be required for the successful operation of the temperature regulation systems specified herein and/or shown on Drawings.

B. Cumulators shall be of the positive and gradual acting type.

C. Provide suitable indicating plates with all switches.

D. Pressure/Electric switches shall be micro switch type.

E. Range shall be 0 - 20 psi with electrical rating of 10 amperes minimum for 115V/1/60.

2.13 POWER MONITORING:

A. General: Provide current switches, current transducers, voltage transducers, current transformers as required to meet the specified sequence of operation and indicated below.

B. Current Operated Switches: AC current switch, Neilsen - Kuljian Model PD50AC, or PD75, solid state, 5 year warranty, three selectable ranges for optimum adjustability and resolution. Provide external current transformer where required.

C. Current Transducers: AC current to DC current output, ±.5% accuracy, 4-20 mA output signal, Kele and Associates Model 4CMA. Provide external current transformer where required.

D. Voltage Transducers: Kele & Associates Model PVM or LVM as required for each application, ±1/2% accuracy, 4-20 mA DC output.

2.14 VIBRATION MONITORING:

A. Vibration Switch: Kele & Associates Model 502 vibration switch, frequency range of 120 to 30,000 CPM, 3 second time delay to prevent triggering due to transients 4-20 mA output signal, capable of being wired for automatic reset or latch and remote reset, ±5% accuracy, alarm setpoint and shutdown limit, NEMA 4 enclosure, capable of being mounted with the sensitive axis in any plane including inverted position and a velocity range of .15 to 1.5 in/sec.

2.15 GAS DETECTION SENSORS:

A. Carbon Dioxide Sensor: Viasala GMD20 (Duct) GMW20 (Wall); , designed to monitor CO_2 levels, in accordance with ASHRAE Standard 62,4-20 mA output, accuracy at 20deg C <(20ppm +1.5% of reading), 0-2000 PPM range, adjustable to 20000 ppm.

B. Refrigerant Leak Detection: MSA Instruments. "CHILLGARD RT" leak detection system, monitor and multipoint sequences, complies with ASHRAE Standard 15, 0-100 PPM, 10% reading, 0-100 PPM linear reading, ±2% of full scale for 100-1000 PPM, 1 PPM sensitivity for R-123, resolution of 1 PPM, capable of 6 sampling points, suitable for either R-123, R-134A, R-22, ammonia, complete with alarm relays, 4-20 mA analog output, NEMA 4 enclosure, calibration kit, audible horns, zero & span gas scrubber.

C. Carbon Monoxide Sensor: Kele & Associates Model WCO-1, solid state sensor with a life expectancy of over 10 years, 0-200 PPM digital display, 4-20 mA analog output, test switch, automatic calibration and kit, alarm relay contact. Provide multiple sensors for adequate coverage. Each sensor shall be individually wired directly back to controller.

D. Oxygen Monitor Sensor: Davis Instruments Teledyne Model 335, with a range of 0-25% O_2, 0.5% sensitivity of full scale, ±2% accuracy at constant temperature, solid state electronics, two adjustable alarm setpoints and form C relay contacts, built-in audible and visual indication, AC powered, NiCad battery back-up and battery test switch. Provide calibration equipment and span gas.

2.16 TEMPERATURE CONTROL CABINETS:

A. General: All controllers and field interface devices shall be installed in control panel cabinet/enclosure as described below.

B. Cabinets shall be UL listed, 14 gauge furniture grade steel, finished with baked enamel painted finish inside and out, cabinet doors shall have piano hinge and standard key cylinder locking latch.

C. Cabinets shall include Lexan windows to view controls without opening the door.

D. Control panels located outdoors shall be NEMA 4X.

E. All devices installed in or on the control cabinet shall be labeled with a fixed mounted, color contrasted, engraved laminated plastic tags, including describing the function of the device, similar to the following example:

ΔP TRANSMITTER DEVICE

Label

DSP-1, AHU-1 SUPPLY DUCT STATIC PRESSURE TRANSMITTER

F. All electrical devices within the panel shall be prewired to terminal strips with all inter-device wiring within the panel completed prior to installation of the system.

G. Mount control panels adjacent to associated equipment on vibration free walls or free standing steel angle supports or "Unistrut" support stand.

2.17 VARIABLE FREQUENCY DRIVES:

A. Variable frequency drives shall be arranged so that it can be operated in an open circuit mode, disconnected from the motors, for start-up adjustments and trouble shooting.

B. Automatic operation shall be from a 4-20 milliamp signal follower, which shall follow a transducer signal. The signal follower shall contain the following design features.

1. Shall accept a transducer output signal and condition it to produce a speed reference signal for the invertor.
2. Minimum speed adjustment (Zero to Maximum RPM).

C. Wire all safeties to operate both in hand and auto positions as well as drive and by-pass sections.

D. Provide communication cabling and interface necessary to forward VFD computer communication information to and from the BAS/VFD. See Section 23 05 07.

2.18 HIGH & LOW TEMPERATURE LIMIT CONTROL DEVICES:

A. Provide PENN A70 series or equal, DPST, manual reset, two isolated sets of contacts. Control responds to temperature along any one foot of entire element.

B. Vapor charged sensing element shall be calibrated for altitude of project site.

C. Provide multiple limit control devices as required to provide complete and full coverage of the entire coil face area and/or duct cross section area.

2.19 ELECTRICAL MATERIALS:

A. All wiring shall be installed in conduit. See Division 26 for conduit installation requirements. Where wiring is exposed in plenum locations (i.e. open cable tray, wiring shall be plenum rated.

B. Conduit and Conductors: Types as indicated in Division 26 sized per Division 26 except for low-voltage twisted pair or single jacketed cable (1/2" minimum). All low voltage conductors shall be stranded 22 gauge copper minimum; twisted pair.

C. Fittings per Division 26: Bushings or nylon insulated throats are not required for jacketed cables.

D. All J-boxes shall be identified and labeled per Division 26.

E. All conductors and cables shall be labeled per Division 26.

F. Conduit and box supports shall be per Division 26.

G. Junction boxes shall be of types and sizes as indicated in Division 26.

H. Conduits shall not exceed 40% maximum fill for single conductor and jacketed cables.

I. Fiber Optic Cable:

1. Acceptable fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140. Only glass fiber is acceptable, no plastic.
2. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

J. Coaxial Cable:

1. Coaxial cable shall conform to RG62 or RG59 rating.
2. Provide plenum rated coaxial cable when running in return air plenums.

K. All temperature control panels & controllers shall be provided with fuse protection on both incoming power load supply (primary side) and on low voltage side of control transformer (secondary side).

L. Provide lightning arresters Kele & Associates Model 392-SVSR2 or equal, at all points where communication cables exit or enter the building.

M. All communication cabling shall be shielded type.

2.20 END SWITCHES:

A. All end switches shall be NEMA rated contacts and NEMA 4X enclosure, either SPDT, DPDT DPST as required to meet the sequence of operation, complete the points list and necessary interlocks or safeties control wiring. End switches shall be as manufactured by Cutler-Hammer or Allen-Bradley.

B. All end switches shall be designed and configured to provide positive indication of a control device (i.e. damper or valve) position for the service intended.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The Contractor shall install all equipment, control air piping/tubing, conduit and wiring parallel to building lines.

B. All automatic control valves and control dampers furnished by the Temperature Control Contractor shall be installed under his supervision by the Mechanical Contractor.

C. GENERAL INSTALLATION REQUIREMENTS:

1. Spare conductor capacity, equal to a minimum of (2) additional sensors shall be provided to each underfloor sensor and pendant type sensors.
2. Wiring shall be installed in conduit throughout.
3. Horizontal runs of conduit, trays, tubing or wiring shall be hung from structural members using new supports, or where feasible, utilizing existing temperature control conduit and piping. The Contractor shall verify adequacy of existing systems and warrant these systems as if they were new. Single runs of conduit, tubing or wire shall be by clevis ring and all thread rod. Multiple runs shall be by "Trapeze" or "Unistrut" supports. "Plumber's Strap" shall not be allowed. Maximum distance between supports shall be per the NEC. Existing supports shall only be used upon written concurrence by the Architect, Engineer or Owner.
4. All vertical runs of conduit or tubing shall be through new core drills. Existing core drills may be used if approved by the Owner. The installation shall be supported above each floor penetration using clamps to "Unistrut".
5. All wire that enters or leaves a building structure shall be installed with lightning protection per NEC.
6. All wire terminations shall be with compression type round hole spade lugs under a pan head screw landing; Stay-Kon or equivalent. All wire splices shall be with compression type insulated splice connectors or properly sized "wire-nut" connectors. Hand twisted, soldered and/or taped terminations or splices are not acceptable.
7. Where tubing, wiring or conduit penetrates floors or walls, sleeves with bushings shall be provided for tubing and wires. The conduit or sleeve opening shall be sealed with fire proof packing so the smoke and fire rating of the wall or floor is maintained.
8. building structure or supports furnished by this Contractor.

D. Control Wiring:

1. Run wiring in metallic conduit, tubing or raceways. Exceptions are as follows:

    a. NEC Class 2 low voltage wiring where not exposed to view such as above suspended ceilings, in shafts, etc., may be run in cable (when approved by code authority).
    b. Wiring enclosed in temperature control panels.

2. Where conduit is used, provide steel fittings.
3. Low Voltage Conductors: 18 gauge minimum, except 19 gauge may be used for home runs to central panels and 22 gauge minimum for resistance or thermistor sensing element connections.

4. Wire control interlocks and control panels, except one 120V power circuit to each temperature control panel shown on drawings and schedules shall be provided under Division 1.
5. All wiring shall comply with the requirements of local and national electrical codes.
6. Do not interlock alarms with starter switching to bypass alarm when equipment is manually disconnected.
7. Variable frequency drives shall be arranged so that it can be operated in an open circuit mode, disconnected from the motors, for start-up adjustments and trouble shooting.
8. All costs of controls, wiring conduit and associated labor shall be included in the temperature control bid. The control wiring shall be installed under the supervision of this Contractor.

3.2 ENCLOSURES:

A. The tubing and wiring within all enclosures shall be run in plastic trays. Tubing and wiring within BAS panels may be run using adhesive-backed tie wraps.

B. All plastic tubing shall be connected to enclosures through conduit. All copper tubing shall be connected to enclosures through bulkhead fittings.

C. Mount all enclosures, including those which house BAS Panels, Slaves and Field Device Panels, so that the top of the enclosure does not exceed six feet, six inches (6'-6"); and the center of any keypad/LCD combination does not exceed five foot, six inches (5'-6") from the floor or is less than four feet zero inches (4'-0") from the floor.

D. Field Device Panels contain related Field Devices such as relays, control power (24V) transformers, output transducers, etc., that are outboard of the BAS Panels or Dedicated Controllers. Each Field Device Panel shall be mounted within an enclosure. The enclosures shall be provided with lockable latches that will accept a single key common to all Field Device Panels, BAS Panels and Slaves.

3.3 IDENTIFICATION:

A. All control air piping/tubing, J-boxes, conduit and wiring shall be labeled.

B. Electrical devices, wiring, conduit and J-boxes shall be labeled and identified as required by Division 26.

1. As a minimum regardless of Division 26 requirements, all temperature control J-box covers shall be painted blue in color on both sides of cover.

C. Main supply control air piping and tubing shall be labeled with Brady or equivalent markers or pre-printed identification sleeves at each end and junction point, and protected. Identification scheme shall be consistent with the drawings.

D. Identification shall be provided for all enclosures, panels, junction boxes, controllers or Field Devices. Laminated, bakelite nameplates shall be used. The nameplates shall be 1/16-inch thick and a minimum of 1 inch by 2 inches. The lettering shall be white on a blue background with minimum 1/4-inch high engraved letters. The nameplates shall be installed with pop rivets.

1. All new devices will be tagged. Color code to differentiate between new devices.

E. Thoroughly clean the surface to which the label shall be applied with a solvent before applying the identification. Use an epoxy to affix the identification in addition to any adhesive backing on the identification.

F. The plan code designation shown on all shop drawing identification shall be consistent with the contract documents.

G. All I/O Field Devices that are not mounted within Field Device Panel enclosures shall be identified with engraved plastic laminated nameplates installed so that they are visible from ground level.

H. The identification shall show the designation used on the record documents and identify the function such as "mixed air temperature sensor" and "fan status DP switch".

I. Calibration settings shall be marked with paint or indelible ink.

3.4 LOCATIONS:

A. All sensing devices and locations shall be located by the Contractor as shown on the submittal shop drawings with final review by the Engineer.

B. Wall mount space sensors shall be mounted five (5) feet above finished floor. Pendant mount space sensors shall be mounted eight (8) feet above finished floor.

C. Enclosures housing Field Devices shall be located immediately adjacent horizontally to the BAS panels or Slaves which are being interfaced to.

3.5 VALVES, WELLS, FLOW SWITCHES AND AUTOMATIC CONTROL DAMPERS:

A. The Controls Contractor shall have his control equipment on the project site when required and give the Owner 24 hour written notice when systems must be shut down for installation.

3.6 TEMPERATURE SENSORS:

A. Temperature controls trades shall verify all wall mounted temperature sensors locations with the Architect/ Engineer/Owner in order to avoid interference with wall mounted and space furnishings.

1. Where interferences require moving the temperature sensor more than two feet, consult with the Architect/Engineer for relocation.

B. Temperature sensors shall be mounted on suitable insulated base and secured to the wall in such a way as to be easily removed from wall without damage to the sensor.

C. Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats 48" (1524 mm) above floor.

3.7 EQUIPMENT PROTECTION AND COORDINATION:

A. Where existing walls are penetrated with conduit or piping, provide a fire stop assembly which meets or exceeds the original rating of the assembly. Refer to Division 23.

B. Extreme care must be exercised while working in existing facilities and around operating equipment, particularly sensitive telephone switching and computer equipment. Close coordination with the Owner is required for the protection of this operating equipment from dust, dirt and construction material while maintaining the operational environment for the equipment. Under no circumstances shall the power or environmental requirements of the operating equipment be interrupted during the installation and check-out without submitting to the Architect, Owner and Engineer for approval.

C. A detailed Method of Procedure (MOP) stating the steps to be taken, time schedule and impacted systems for the service interruption shall be submitted to the Architect for approval prior to beginning work. Refer to Division 1 and Division 23 for requirements.

3.8 CLEANUP:

A. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of all grease, plaster, dust, or other foreign materials.

B. Upon final completion of work in an area, vacuum and/or damp wipe all finished room surfaces and furnishings. Use extreme care in cleaning around telephone switching and computer equipment and under no circumstances shall water or solvents be used around this equipment.

C. At the completion of the work and at the end of each work day, remove from the building, the premises, and surrounding streets, etc., all rubbish and debris resulting from the operations and leave all equipment spaces absolutely clean and ready for use.

3.9 SOFTWARE, DATABASE AND GRAPHICS:

A. Software Installation: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

C. Color Graphics: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays for all systems which are specified with a sequence of operation, depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the Owner.

3.10 TEMPERATURE CONTROL DRAWINGS:

A. Upon completion of project and after record drawings of the temperature controls have been prepared and reviewed, the Contractor shall provide one (1) complete set of temperature controls drawings at each temperature control panel. Each set of drawings shall be laminated in a plastic coating. The drawings shall consist of only those control functions associated with the specific control panel and any relevant or pertinent network interface information.

B. The laminated drawings shall have a grommet connection attached to a metal cable or chain which is mechanically fastened to the temperature control cabinet.

3.11 START UP AND TESTING:

A. Prior to Beneficial Use of the BAS, the Contractor shall supply to Architect/Engineer two (2) debugged printouts of all software entered into the BAS. Also supply all users programming and engineering manuals required to interpret the software. Included in the printouts, though not limited to, shall be the following:

1. Point data base.
2. All custom control programs written in the BAS control language.
3. All parameters required for proper operation of BAS control and utility firmware such as start-stop routines, etc.
4. Printouts or plotted detailed copies of the complete interactive system graphics.

B. The software printout shall be fully documented for ease of interpretation by the Architect/Engineer and Owner, without assistance from the Contractor. English language descriptions shall be either integrated with or attached to the BAS printout. Specifically, the following shall be documented:

1. All point (I/O and virtual) names.
2. All BAS Programming Language commands, functions, syntax, operators, and reserved variables.
3. Use of all BAS firmware.
4. The intended actions, decisions, and calculations of each line or logical group of lines in the custom control program(s). Sequences of operation are not acceptable for use in this documentation requirement.
5. Complete descriptions of and theories explaining all software and firmware algorithms. The algorithms to be described include, but are not limited to, PID, optimum start/stop, demand limiting, etc.

C. Documentation that was supplied as part of the submittals need not be submitted at this time.

D. Upon review of software, a point-to-point test of the BAS installation shall commence. The Contractor shall provide two men equipped with two-way communication and shall test actual field operation of each control and sensing point. The purpose is to test the calibration, response, and action of every point. Any test equipment required to prove the proper operation of the BAS shall be provided by and operated by the Contractor. Demonstrate compliance that system functions per the Sequence of Operation.

1. Upon review of the point-to-point demonstration, the Contractor shall start up the BAS by putting all controlled equipment in automatic and enabling software. Contractor shall commence final software and overall BAS hardware/software debugging.

E. Final acceptance of the BAS is contingent upon a hardware/software system test. All groups of points that yield a system of control shall be tested for compliance with the sequences of operation. Included in the test, but not limited to, shall be:

1. BAS loop response. The Contractor shall supply a trend data output in graphical form showing the step response of each BAS loop. The test shall show the loop's response to a change in set point which represents a change in the actuator position of at least 25% of its full range. The sampling rate of the trend shall be from one to three minutes depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that does not yield temperature control of + 0.2deg F or humidity control of + 3% RH shall require further tuning by the Contractor.
2. Interlocks and other sequences.

3. BAS control under HVAC equipment failure.
4. HVAC operation under BAS equipment failure.
5. Battery backup.
6. BAS control under power failure/restart.
7. Reset schedules.
8. BAS alarm reporting capability.

F. A detailed test report as defined under Submittals shall be provided indicating its completion and proper system operation.

G. The BAS will not be accepted as meeting the requirements of Beneficial Use until all tests described in this section have been performed to the satisfaction of both the Architect/Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor shall be exempt from the Beneficial Use requirements if requested in writing by the Contractor and concurred by the Owner and Architect/Engineer. Such tests shall be performed as part of the BAS warranty.

1. A typed written document stating that the system has been fully checked out on a point by point basis shall be submitted to the Architect/Engineer. All documentation associated with the checkout shall be included.

3.12 PROJECT RECORD DOCUMENTS:

A. The Contractor shall be responsible for updating all existing Project Record Documents associated with the Scope of Work outlined in the Drawings and Specifications.

B. Prior to final completion of the installation, prepare a complete set of record drawings on a clear and legible set of ANSI size 'B' (11" x 17") Mylar reproducible prints. The content, format and procedure of the submittal shall be as described by the General Conditions.

C. Provide one laminated and framed set of control drawings for each new BAS control panel and one for the Facility Control Room, locate as directed by the Engineer.

D. Prior to final completion of the installation, prepare three (3) operation and maintenance manuals. The information is to be inserted in the existing operation and maintenance manuals or provided in a tabbed and indexed, 3 screw and post binder. The information shall include:

1. Operator's manual with step-by-step procedures for logging on/off, interrogating the system, producing reports, acknowledging alarms, overriding computer control, and changing firmware parameters.
2. Programmer's manual with complete description of the custom control language and associated editor, including sample written programs. Provide complete sets of all programming forms, applications memorandums, and addenda to the programmer's manual. All software or firmware algorithms shall be completely described and documented.
3. Maintenance, Installation, and Engineering manual(s) that clearly explains how to debug hardware problems, how to repair or replace hardware, preventive maintenance guidelines and schedules, calibration procedures, and how to engineer and install new points, panels, and Operator Interfaces.
4. Documentation of all software. List separately all software parameters that will need updating by the Owner such as, though not limited to, holiday, seasonal and start/stop schedules, comfort and duty cycling schedules.
5. All programs, code, databases, graphic files, CADD drawings and symbol libraries generated for operation of the system shall be included as a part of the system

documentation. This information shall be submitted both in hard copy bound format and magnetic media format.

6. Input/output schedules, data sheets, and all other items required under Submittals. Describe all regular maintenance that will need to be performed on the BAS hardware. List replacement parts with part numbers.
7. Complete original issue documentation and software diskettes for all third party software furnished and installed as a part of the system or required for the operation of the system including text editors, control language program and compiler, database managers, graphics and CADD packages, operating systems and communications software.
8. Complete original issue documentation, installation and operational manuals and supporting software for all third party hardware furnished and installed as a part of the system or required for the operation of the system including remote terminals, user's computer workstation, monitors, graphics and memory boards, printers and modems.
9. During the warranty period, all copies of the drawings and manuals shall be updated to include all hardware and software changes. A final update at 1 year shall be provided to the Owner.

E. All of the above documentation shall record both the equipment installed under this contract and the exact termination to all other existing control or BAS equipment.

F. The record drawings shall document the complete existing control system. This includes all mechanical equipment in work area which has automatic control.

3.13 WARRANTY:

A. The Warranty period shall begin on the date of beneficial use completion as authorized by the Architect/Engineer and Owner in writing. Beneficial use shall not occur before the Contractor has performed the tests required. With these requirements met, beneficial use shall not occur until, in the opinion of the Architect/Engineer, the BAS is sufficiently complete to be utilized for the purposes for which it is intended.

1. The warranty start date shall not begin until all phases of the Project are complete, i.e., the Project shall have a single warranty start date.

B. The BAS system shall be guaranteed to be free from defects in material and workmanship and in software design and operation for a period of the warranty after completion of the contract. The Contractor shall provide the necessary skills, labor, and parts to assure the proper operation of, and to provide all required current and preventive maintenance. This warranty shall become effective starting the date of Beneficial Use completion.

1. The hardware warranty shall include all equipment which has been purchased by the Contractor. The existing hardware is not subject to the warranty requirements.
2. All software work completed by the Contractor, associated with existing hardware, is subject to the warranty requirements outlined herein.
3. The Contractor shall respond to all calls during the warranty period for all problems or questions experienced in the operation of the installed equipment and shall take steps to correct any deficiencies that may exist.
4. The response time to any problems shall be four (4) hours maximum 24 hours per day, 7 days per week. Corrective action, temporary or permanent shall be made within one business day.

C. The Contractor shall perform a monthly on-site or via telephone MODEM inspection of the operation of the system. They shall report to the Owner in writing after each inspection, define any problems with the system and its operation, and define the procedure which will be taken to

correct the problem. Contractor shall comment on the possible resolution of any problems that are out of the scope of their Contract.

1. Any problems shall be corrected as required by the warranty requirements.

D. The system shall be polled via the telephone modem for any alarm signals or "abnormal off" messages. Upon receiving such a message the Contractor shall take indicated corrective action.

E. The Contractor shall maintain a backup of all BAS software installed in the system. The backup shall be updated monthly or whenever a change to the software is made. A reload of backup software into the system shall be performed by the Contractor immediately upon notification by the Owner. The reload shall be free of charge unless it is due to a power failure of a duration longer than the battery backup.

F. The Contractor shall optimize all control software to assure acceptable operating and space conditions, and peak energy efficiency.

G. At the end of the warranty period, the Contractor shall supply updated copies of the latest versions of all Project Record Documentation. This includes final updated drawings, software documentation and magnetic media backups that include all changes that have been made to the system during the warranty period.

3.14 TRAINING:

A. The Contractor shall provide 10 hours of training for the building operators. The training sessions shall be broken into 5 2-hour sessions. The training session shall be made available to the Owner prior to the end of the warranty period but after final completion of the contract. The session shall be given at the Owner's facility. Scheduling shall be approved by the Owner. The training shall focus on general design, operation, and maintenance procedures of the products installed, though not necessarily the specific system designed, and shall cover:

1. Hardware configuration including PC boards, switches, communication and point wiring, and location and installation of all sensors and control devices.
2. Hardware maintenance, calibration, troubleshooting, diagnostics, and repair instructions.
3. Operation of man-machine interface including logging on/off, interrogating the system, producing reports, acknowledging alarms, overriding computer control, and changing firmware/software parameters.
4. Programming the BAS using the editor and the design of custom control software.
5. Recovery procedures from both BAS and HVAC failures.

B. The Instructor for the above session shall be an employee of the Contractor, who is qualified to provide customer training and applications support.

END OF SECTION 230900

SECTION 230993- SEQUENCES OF OPERATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.

B. Operating equipment, devices, and system components required for control systems are specified in other Division 23 Controls' sections of these specifications.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS:

A. Provide control systems consisting of thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified.

B. Provide necessary materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise. Generally, self-contained valves, filter gauges, liquid level controllers and similar instruments, are not to be installed under this section.

C. Unless specified otherwise, provide fully proportional components.

D. Provide all necessary relays and signal boosters to make the system a full and operable system as required by the sequence of operation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Coordinate with the Owner's Facility Management staff for final determination of Occupied/Unoccupied Modes for each system.

B. Coordinate with the Building Owner's Facility Management staff to determine the critical level of each alarm condition, methods of notification required (email, pager, phone call, etc.) and the staff to be notified based upon the alarm level.

C. Coordinate with Owner to have alarm indications repeat after silencing if sensed condition continues. Coordinate time intervals for repeat of various alarms.

1. All alarms shall include a Time/Date Stamp using the standalone control module time and date.

2. Each alarm can be configured in terms of criticality (Critical/Not Critical), operator acknowledgement (Requires Acknowledgement / Does Not Require Acknowledgement), and conditions required for an alarm to clear automatically (Requires Acknowledgement of a Return to Normal / Does Not Require Acknowledgement of a Return to Normal).
3. An operator shall be able to sort alarms based on level, time/date, and current status.
4. Alarms should be reported with the following information:

    a. Date and time of the alarm.
    b. Level of the alarm.
    c. Description of the alarm.
    d. Equipment tags for the units in alarm.
    e. Possible causes of the alarm, if provided by the fault detection routines.
    f. The source which serves the equipment in alarm it provides resources to a downstream component, such as a chiller providing chilled water to an AHU.

D. Alarm definition shall be as follows unless modified by the Owner. Coordinate with Owner for each alarm the level they desire the BAS to indicate.

1. Level 1: Critical/Life Safety.
2. Level 2: Significant Equipment Failure.
3. Level 3: Non-Critical Equipment Failure/Operation.
4. Level 4: Energy Conservation Monitor.
5. Level 5: Maintenance Indication, Notification.

E. Space Temperature Setpoints: The following adjustable temperatures shall be the baseline control setpoints for spaces unless indicated otherwise later in this document. Coordinate with Building Owner's Facility Management staff for final temperature settings to be provided.

Space	Heating, Occupied	Heating, Unoccupied	Cooling, Occupied	Cooling, Unoccupied
General	70°F	65°F	75°F	85°F
Vestibules	50°F	N/A	None	None
Corridors	70°F	65°F	75°F	85°F
Toilet Rooms	70°F	65°F	75°F	85°F
Conference Rooms	70°F	65°F	75°F	85°F
Classrooms	70°F	65°F	75°F	85°F
Offices	70°F	65°F	75°F	85°F
Telecom Rooms	65°F	N/A	70°F	None
Storage Rooms	50°F	N/A	80°F	85°F
Mechanical Rooms	50°F	N/A	80°F	85°F
Electrical Rooms	50°F	N/A	80°F	85°F

3.2 TERMINAL BOX CONTROL SEQUENCES:

A. Variable Air Volume with Reheat: The thermostat shall control the damper operator on the variable volume, pressure independent terminal box. On a drop in room temperature below thermostat set point, the thermostat shall modulate the airflow minimum scheduled air quantity to satisfy thermostat cooling set point. On further drop in room temperature below thermostat heating set point, the thermostat shall modulate the reheat coil normally open two-way control

valve and increase the air flow to satisfy thermostat set point. On rise in temperature above the thermostat set point, the thermostat shall close the normally open two-way control valve and modulate the airflow to maximum scheduled air quantity.

B. Morning warm-up sequence shall be provided so that the VAV boxes go to full heating during this 1 hour period from 6:00 am to 7:00 am (adjustable). During this time, the VAV shall open to full cooling cfm with 75 degree entering and approximately 88 degree leaving air temperature.

C. Post Morning Warm-up, minimal or unoccupied time sequence: Once the morning warm up is complete and after a 15 minute delay all VAV boxes shall open to a minimum occupied set point.

END OF SECTION 230993

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SECTION 233113- METAL DUCTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

DUCT SERVICE	TYPE/CONSTRUCTION
Supply air between fan and terminal boxes (medium and high).	Galvanized steel, spiral, round or oval or rectangular.
Rectangular supply air from discharge of terminal box/fan to air devices (low pressure).	Galvanized sheet metal /spiral round and oval or rectangular (lined as noted on drawings.)
Return air ductwork.	Galvanized steel (lined where noted on drawings); factory or shop fabricated.).
General building exhaust.	Galvanized sheet metal (lined as noted on drawings); factory or shop fabricated.).
Transfer ducts.	Internally lined galvanized sheet metal as described above for low pressure supply; factory or shop fabricated.
Sound elbows for R.A. grilles	Galvanized sheet metal (internally lined). OR Fibrous glass ductboard.

B. Exterior insulation of metal ductwork is specified in other Division-23 sections, and is included as work of this section.

C. Refer to other Division-23 sections for ductwork accessories.

D. Refer to other Division-23 sections for fans and air handling units.

E. Refer to other Division-23 sections for testing, adjusting, and balancing of metal ductwork systems.

1.2 DEFINITIONS:

A. Low Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to 2" or less, positive or negative pressure class.

B. Medium or High Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to greater than 2" positive or negative pressure class.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. References to SMACNA, ASHRAE and NFPA are minimum requirements, the Contractor shall fabricate, construct, install, seal and leak test all ductwork as described in this specification and as shown on the drawings, in addition to these minimum standard references.

D. Codes and Standards:

1. SMACNA Standards: Comply with the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.
2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

E. SMACNA Industrial Construction Standards.

F. Field Reference Manual: Have available for reference at project field office, copy of the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible", and the current SMACNA "HVAC Air Duct Leakage Test Manual".

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for ductwork materials and products. Provide product data for manufactured joining systems. Include sound attenuation by octave band for sound rated flexible duct.

B. Shop Drawings: Submit ¼" scaled fabrication and layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed systems, in accordance with requirements of Divisions 1 and 23.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Divisions 1 and 23.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Store ductwork inside elevated from floor on pallets and protected from weather, dirt, dust and debris.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Duct Liner:

a. Johns Manville

2. Flexible Ducts:

a. Flexmaster

3. Duct Take Off Fittings

a. Hercules Industries
b. Flexmaster

2.2 DUCTWORK MATERIALS:

A. Exposed Ductwork Materials: Where ductwork is exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains, dents, discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 653, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Provide flat seam construction where standing seams are a hazard to the Owner's operation personnel.

2.3 MISCELLANEOUS DUCTWORK MATERIALS:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.

C. Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated.

1. Unless otherwise noted, provide 1" thick, 1-1/2 lb density, fiberglass duct liner meeting ASTM C1071 Type I, NFPA 90A and 90B and TIMA (AHC-101) with minimum NRC (noise reduction coefficient) of 0.70 as tested per STM C 423 using an "A" mounting with minimum "K" factor of 0.25. Lining shall be U.L. approved, made from flame attenuated glass fiber bonded with a thermosetting resin with acrylic smooth surface treatment and factory applied edge coating. Materials shall conform to revised NFPA No. 90A Standards, with a maximum flame spread of 25 and maximum smoke development of 50.

D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".

E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/ installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. All PVC coated exhaust ductwork shall be sealed with an approved chemical resistant sealant as manufactured by McGill Uni-Coat Duct Sealer duct sealer and wrap with hardcast tape. For outdoor ductwork, sealant shall also be U.V. resistant and weather resistant.

G. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless steel ductwork, provide matching stainless steel support materials.
2. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.

H. Flexible Ducts: Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 10" W.C. positive, 1” negative for sizes up to 12” through a temperature range of -20°F to 150°F; minimum working velocity rating shall be 4000 fpm. Contractor shall assume responsibility for supplying material approved by the authority having jurisdiction.

1. All flexible duct shall be rated for sound attenuation. Inner core shall be black CPE supported by a galvanized steel helix, with minimum R-5 insulation and metalized reinforced outer jacket.

a. Flexmaster Type 1M

2. Sound attenuation shall be as scheduled below:

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)							
Octave Band	125	250	500	1000	2000	4000	8000

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)							
8" Diameter	5.6	10.6	23.9	34.0	22.5	17.0	11.9
12" Diameter	6.6	27.8	22.8	29.0	18.7	10.9	8.2

3. Non-insulated flexible ducts shall be the same as insulated less the insulation and other jacket.

I. Duct Take Off Fittings to Individual Air Inlets & Outlets: Provide conical spin-in fittings at flexible or round sheet metal duct takeoffs. Where specifically shown on drawings, where the duct dimension does not allow for a conical spin-in, or at Contractor's option, provide 45° inlet rectangular to round duct take off fittings, with factory applied gasket. Fittings shall include butterfly type manual volume damper with regulator, and dual locking device. Dual locking device shall consist of two shaft mounted wing nuts, one on each side of the damper. Wing nuts shall tighten on shafts to lock butterfly in place. Shafts shall be solid metal, rolled metal shafts are not acceptable.

J. Duct take off fittings to air terminals: same as for individual air inlets and outlets, less the damper.

2.4 FABRICATION:

A. Fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match (-) mark sections for reassembly and coordinated installation.

B. Fabricate ductwork of gauges and reinforcement complying with the latest SMACNA "HVAC Duct Construction Standards". Minimum 26 GA where ducts are within corridors.

C. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.

D. If manufacturer flange joining systems are used as part of the reinforcing, the EI rating and rigidity class shall be equivalent to the reinforcing requirements of the standard. Submit manufacturer's product data.

E. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows and offsets with center-line radius equal to 1.5 times the associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. 90° mitered elbows with turning vanes may be used where specifically shown on drawings. Mitered elbows or offsets of other than 90° shall not be used. Two 90° mitered elbows shall be separated by a minimum of 2 equivalent duct diameters. Use radiused “Ogee” for offsets less than 90°. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers. Divided flow fittings shall be 45° inlet branches, stationary splitters and elbows, or as shown on drawings.

F. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements. All exhaust ductwork accessories (including dampers, turning vanes, access doors, etc.) shall be Heresite or PVC coated. All stainless steel ductwork shall have stainless steel accessories (including dampers, turning vanes, access doors, etc.) construction.

G. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Provide sheet metal nosing on all leading edges preceded by unlined duct, at duct openings, and at fan or terminal unit connections.

2.5 ROUND AND FLAT OVAL DUCTWORK:

A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized. Spiral lockseam construction. Individual runouts to air devices may be longitudinal seam.

B. Gauge: In accordance with the SMACNA “HVAC Duct Construction Standards”, minimum 26 gauge.

C. Elbows: One piece construction for 90 deg. and 45 deg. elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Radius to centerline shall be 1.5 times duct diameter. Spot welded and bonded construction. Elbows on runouts to individual air devices may be pleated or adjustable.

D. Divided Flow Fittings: 90 deg. tees, constructed with branch spot welded and bonded to duct fitting body, or saddle tap fitting, with minimum 2" flange shaped to fit main duct.

PART 3 - EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL DUCTWORK:

A. Duct Sealing:

1. Seal all low pressure ducts to SMACNA Seal Class "B".
2. Seal all medium and high pressure ducts to SMACNA Seal Class "A".

B. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.

C. Construct ductwork to schedule of operating pressures as shown on drawings.

D. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

E. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

F. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

G. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

H. Slope shower, locker room, and high moisture ductwork down to air device.

I. Penetrations: Where ducts pass through fire rated walls and do not contain fire or smoke dampers, protect with fire stop material installed in accordance with its listing. Where ducts pass through interior partitions or exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four sides by at least 1-1/2". Fasten to duct only. Where ducts penetrate non-fire rated, mechanical, electrical or acoustically sensitive walls, provide ½" to ¾" annular space between duct and wall, pack annular space with mineral wood insulation, and caulk both sides with non-hardening acoustical sealant.

J. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

K. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards and Industrial Construction Standards.

L. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.3 INSTALLATION OF DUCT TAKE-OFF FITTINGS:

A. Fully seal all joints.

B. Sheet metal screw regulator arm to duct after balance is complete. Mark and date position of regulator arm.

C. Insulation over regulator arm is not required.

3.4 INSTALLATION OF DUCT LINER:

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.5 INSTALLATION OF FLEXIBLE DUCTS:

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6' - 0".

B. Installation: Install in accordance with SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".

C. Full inside diameter of flexible duct shall be maintained. Support to prevent kinking.

D. Flexible duct shall not be installed above an inaccessible ceiling unless the air device is set in a frame allowing access to both ends of the flexible duct.

3.6 FIELD QUALITY CONTROL:

A. Leakage Tests: Conduct duct leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.

B. General:

1. Ductwork pressure tests shall be observed by Architect/Engineer prior to installation of insulation.
2. Ductwork systems in ±3" W.G. pressure class and higher shall be tested in their entirety for leaks. Arbitrary sections of ductwork in ±2" W.G. and lower pressure class shall be tested as required by Architect/Engineer.
3. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof.

C. Test Equipment:

1. Portable rotary type blower or tank type vacuum cleaner with control damper. Equipment shall have sufficient capacity to properly test reasonably large duct system section. Equipment shall have been calibrated within 2 years of the testing.
2. Orifice assembly consisting of straightening vanes and calibrated orifice plate mounted in a straight tube with properly located pressure taps.
3. Two (2) U-tube manometers, one to measure drop across calibrated orifice and one to measure S.P. in duct being tested. Provide low differential pressure Dwyer magnehelic gauges for low leak testing in lieu of U-tube manometers.
4. Provide Dwyer magnehelic gauge with 0-.25" W.C. range for testing 0% leakage ductwork.

D. Testing Pressures and Permissible Leakage:

1. Test pressure shall be equal to the construction class. Negative pressure duct shall be tested at the equivalent positive pressure.
2. Allowable leakage shall be determined from the following equation (or figure 4-1 in the above referenced Standard):

   $F = C_L (P)^{.65}$

   Where: F = Allowable leakage factor CFM/100 Sq. Ft.
   C_L = Leakage Class
   P = Test pressure inches W.C.

3. Leakage class shall be as follows:

   a. Seal class A, Round or oval duct, $C_L = 3$.
   b. Seal class A, Rectangular duct, $C_L = 6$.
   c. Seal class B, Round or oval duct, $C_L = 6$.
   d. Seal class B, Rectangular duct, $C_L = 12$.
   e. Seal class C, Round or oval duct, $C_L = 12$.
   f. Seal class C, Rectangular duct, $C_L = 24$.

4. Record all tests using the procedure and forms in the above referenced standard.
5. All plenums and casings shall be tested by pressuring to the pressure class indicated and visually observing leakage and panel deflection.

   a. No noticeable leakage shall be allowed.
   b. Deflection shall be less than 1/8" per foot.

3.7 EQUIPMENT CONNECTIONS:

A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where required for service, maintenance and inspection of ductwork accessories. See section 23 33 00.

3.8 ADJUSTING AND CLEANING:

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances. Where ductwork is to be painted clean and prepare surface for painting.

B. Protection:

1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
2. Cover all stored ducts to protect from moisture, dust or debris.
3. Maintain a cover on all ends of installed ductwork at all times, except when actually connecting additional sections of duct.

C. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.

1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
2. Ductliner in installed ductwork which has become wet must be completely removed and replaced.
3. Torn ductliner may be repaired by coating with adhesive if damage is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

D. Protect lined duct from becoming wet or torn.

E. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

F. Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 233113

SECTION 233300- AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

C. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers" and U.L. Standard 555S "Motor-Driven Fire/Smoke Dampers."

D. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

E. SMACNA Compliance: All exhaust ducts comply with "Fire Damper and Heat Stop Guide".

F. All fire dampers, smoke dampers, fire/smoke dampers and radiation dampers shall meet the latest local building code requirements.

1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components. Include details of construction equipment and accessories being provided.

C. Submittals for all damper types specified in this section shall include a schedule for each damper indicating net free area, actual face velocity and pressure drop (at sea level) based on net free area & the maximum air quantity which will be passing through the damper. Submittals without this information will be rejected.

D. Submit Heresite duct/equipment protective coating product data sheets and application instruction.

E. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

F. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Dampers:

a. Pottoroff

2. Turning Vanes:

a. Duro Dyne Corp.

3. Duct Hardware:

a. Duro-Dyne Corp.

4. Duct Access Doors:

a. Kees
b. Ductmate
c. Greenheck
d. Flexmaster
e. Cesco-Advanced Air
f. Duro Dyne Corp.
g. Flame Gard

2.2 MANUAL VOLUME DAMPERS:

A. Low Pressure Rectangular Dampers (less than 2000 FPM and under 2" W.C. S.P. Differential):

1. For 12" in height or larger, use multiple opposed blade type and close fitted to ducts. The frame and blades shall be constructed of 16 ga. galvanized steel with plated steel shaft mounted with synthetic bearings. Linkage shall be in-jamb fixed type located outside the airstream made of plated steel tie bar and crank plates, with stainless steel pivots. Damper panels shall not exceed 48" wide. Provide jack shafting when duct size required is greater than 48" wide. Provide notched shaft end indicating damper position, locking quadrant to fix damper position and handle. Provide standoff bracket for insulated ducts. For flat oval and round ductwork, provide type C housing.
2. For ducts less than 12" in height, frame shall be 18 ga. blade galvanized steel, steel axle with synthetic bearings locking quadrant handle and notched shaft end indicating damper position. Provide standoff bracket for insulated ducts.

B. Low Pressure Round Dampers (less than 1800 FPM and under 1" W.C. S.P. differential):

1. For low pressure spin-in fitting dampers serving individual returns/diffusers, see 23 31 13.

2. Dampers 4" diameter through 18" diameter shall be 20 ga. galvanized steel frame and blade, utilize multi-blade square dampers with transitions for ducts over 18" diameter.
3. Axle shaft shall be plated steel with retainers mounted on synthetic bearings with notched end shaft indicating damper position, locking quadrant and handle. Provide standoff brackets for insulated ducts.

    a. Greenheck MBDR-50 or approved equivalent.

C. Medium/High Pressure Rectangular Dampers (less than 4000 FPM and under 6" W.C. (48" wide or less) S.P. or 8" W.C. S.P. (36" wide or less)):

1. Dampers shall be opposed blade for volume control and parallel blade for isolation/shut-off service.
2. Frame shall be 16 ga. galvanized steel with welded corners or 1/8" thick 6063-T5 alloy aluminum frame. Blades shall be double skin galvanized steel with single-lock seam, or .081" thick 6060-T5 extruded aluminum, airfoil shape. Blade edge seals shall be vinyl, silicone, or other approved synthetic and metallic compression seals at the jambs. Axles shall be hexagonal or square plated steel mounted on bronze oilite or synthetic (ACETAL) bearings. Linkage shall be in-jamb type located outside the airstream. Maximum damper size shall be 48" wide and 60" high. For isolation or shut-off duty, damper leakage shall not exceed 9.5 CFM/Ft^2 at 4" W.C. S.P. differential. Provide extended shaft with notched end indicating damper position, locking quadrant and handle. Provide standoff brackets for insulated ducts.

D. Medium/High Pressure Round and Flat Oval Dampers (less than 3000 FPM and under 4" W.C. S.P. differential):

1. Damper frame construction shall be galvanized steel as follows:

ROUND	
Under 6" dia.	12 Gauge
6" to 18" dia	14 Gauge
FLAT OVAL	
6" to 12" wide	2 x 1/2 x 14 gauge channel
13" to 48" wide	2 x 1/2 x 1/8 channel

2. Damper blades shall be galvanized steel as follows:

ROUND	
4" to 18" diameter	12 Gauge
FLAT OVAL	
4" to 18" Wide	12 Gauge

3. Axles shall be 1/2" diameter plated steel up to 18" diameter and 18" wide flat oval, and 3/4" diameter plated steel over 18". Stainless sleeve bearings pressed in to the frame.

4. Provide notched end shaft to indicate damper position, locking quadrant and lever handle. Provide standoff bracket for insulated duct.
5. For isolation or shut-off service dampers shall be provided with edge seals with a leakage rate not to exceed 7 CFM/ft^2 at 1" W.C. S.P. differential (based on 18" diameter).

E. Dampers in stainless steel duct shall be of equivalent construction to the above dampers, with all components made of stainless steel. Type 304 or 316, as specified for the ductwork.

F. Dampers in aluminum duct shall be of equivalent construction to the above dampers, with all components made of either aluminum or stainless steel.

2.3 TURNING VANES:

A. Fabricated Turning Vanes: Provide fabricated 22 gauge, single blade or 24 gauge double bladed 4-1/2" radius, 3-1/4" spacing turning vanes and type 2, 4-1/2" wide runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards" Fig 2.3.

B. Turning vanes as a part of PVC coated air systems shall be PVC coated.

C. Do not use trailing edge turning vanes.

2.4 DUCT HARDWARE:

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

C. Quadrant Locks: Provide for each manual volume damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.5 DUCT ACCESS DOORS:

A. Access Doors for Low Pressure Rectangular Duct: Construct of same or greater gauge as ductwork served, provide double wall insulated doors for insulated ductwork. Exposed insulation adhered to door is not acceptable. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. All access doors shall have gasket and will be air tight. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Where a hinged door cannot be fully opened a removable door may be used.

B. Access Doors for Medium and High Pressure Rectangular Duct: Insulated double wall round door and frame arranged for "Spin-In" installation, with continuous gasket in frame for door. Leakage of less than 0.5 cfm at 6" W.G.

C. Flexmaster "Inspector Series Spin Door" or equivalent.

D. Access Doors for Round Duct 20" and Less: Sandwich type door, constructed of an insulated double wall outer door connected to gasketed inner plate carriage bolts with hand knobs, and formed to fit the radius of the duct.

1. Ductmate "Sandwich" or equivalent.

E. Access Door for Round Duct Greater Than 20": 18" round insulated double wall access door in gasketed frame, attached to duct section similar to tee fitting.

F. Access Doors for Flat Oval Duct: Use door specified for medium and high pressure rectangular duct in flat portion, use door specified for round duct in curved portion.

G. Access Doors for use in Type I commercial cooking hood ductwork (grease exhaust): 16 ga Black Steel, or Stainless steel where used on stainless steel ducts. High temp ceramic fiber gasket rated to 2300 °F. Inner frame to support duct cutout and accept studs and bolts. Multiple studs with wing nut or wing bolts on door. Provide studs as required to accept exterior rated duct wrap to meet wrap assembly requirements. Provide handles. Door assembly shall be rated for temperatures up to 2300°F as required by NFPA 96 and shall be UL listed as a Hood and Duct Accessory. Flame Gard Grease Duct Access Door or equivalent.

H. All access doors in other than standard galvanized steel duct systems shall be of the same material or with the same coating as the duct sytem.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES:

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 deg. elbows in supply, return and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

E. Provide duct access doors whether shown or not for inspection and cleaning upstream of all coils, fans, automatic dampers, fire dampers (minimum 16" x 24" in ducts larger than 18"), fire/smoke dampers, duct smoke detectors and elsewhere as indicated. Review locations prior to fabrication. Provide multiple access doors for large ductwork to provide adequate reach to equipment.

F. Install fire dampers and smoke dampers in accordance with manufacturer’s instructions.

G. Provide fire dampers and smoke dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.

H. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing.

I. Provide balancing dampers on high pressure systems where indicated. Use splitter dampers only where indicated on Drawings.

J. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration. Provide matching flanged backing frame with flexible connector where flanged fan connections are provided.

3.3 COORDINATION:

A. Coordinate with installers of other work to ensure that operators, reset devices, and fusible links are accessible at all fire, smoke, and fire/smoke dampers.

B. Show access space on coordination drawings. Locate over lay-in ceilings and above corridors wherever practical.

C. Order right/left/top/bottom arrangement as required to minimize field modifications.

3.4 FIELD QUALITY CONTROL:

A. Operate installed ductwork accessories after installation to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

B. After installation, test every fire, smoke, and fire/smoke damper for proper operation, provide letter to the Architect/Engineer certifying this work is complete and all dampers are functioning properly.

3.5 ADJUSTING AND CLEANING:

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division-23 section "Mechanical Identification".

C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

E. Touch up all scratches in PVC or Heresite coated surfaces with respective coating finish.

3.6 EXTRA STOCK:

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 233300

SECTION 233600- AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of air terminals work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of air terminals specified in this section include the following:

1. Central Air Terminals

a. Shutoff Single Duct
b. Reheat

C. Refer to other Division 23 sections for related work in addition to the requirements of this section.

D. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on air terminals. Include disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

E. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:

1. Control wiring between field-installed controls and air terminals.

a. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ADC Compliance: Provide air terminals, which have been tested and rated in accordance with ADC standards, and bear ADC Seal.
2. ARI Compliance: Provide air terminals, which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal. Hot water coils shall be tested and rated in accordance with ARI Standard 410.
3. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

D. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

E. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 23.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Air Terminals:

a. Titus

2.2 AIR TERMINALS:

A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Air terminal units shall be low pressure drop, single duct throttling type pressure independent and suitable for use in medium pressure variable volume air distribution systems.

C. Casing shall be minimum 22 gauge galvanized steel construction with internal acoustical coated ½" thick, 1-1/2 lb. density fiberglass insulation and inlet and outlet duct connections. Provide gasketed and insulated access doors for air terminals with internally mounted serviceable components, including actuators and fan motors.

1. Casing shall be insulated with ½", 1-1/2 lb. reinforced foil faced insulation. All edges shall be folded and tucked or protected by sheet metal nosing to isolate all glass fibers from the air stream.

D. Internal damper blade shall be extruded aluminum or 18 gauge steel with keyed fit shaft and nylon bushing. Damper shall seal against gasketed stops maximum 2% leakage at 3.0" S.P. All mechanical parts shall be galvanized or non-ferrous. Alternate damper design as produced by the Trane Company as acceptable.

E. Provide between terminal casing and reheat coil, factory-installed framed duct access door complete with quarter-turn quick release fasteners.

F. Provide label on each air terminal unit, indicating plan designation, unit size, cfm range and settings and calibration curve.

G. Provide a pressure independent pneumatic cross or ring-shaped flow sensor with velocity pressure pickup points for measuring inlet airflow. The sensor shall maintain control accuracy with the same size inlet duct in any configuration. Single point hot wire anemometer or straight line pneumatic sensors are not acceptable. Provide gauge ports in flow sensor tubing.

2.3 AIR TERMINAL UNIT CONTROLS:

A. Air terminal unit manufacturer shall mount DDC controller and electric actuator provided by temperature control manufacturer. See Section 23 09 00.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 COORDINATION:

A. The contractor is responsible for determining the position of controls, actuators, and access. Coordinate each air terminal's position with building elements, piping, conduit, ductwork and other items, order left/right hand units as required and inform all other trades as required. Relocate interfering items or terminal as required to provide proper access if not coordinated beforehand.

3.3 INSTALLATION OF AIR TERMINALS:

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Duct Connections: Connect ductwork to air terminals in accordance with Division-23 ductwork sections.

3.4 FIELD QUALITY CONTROL:

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.5 CLEANING:

A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

3.6 BALANCING:

A. See Section 23 05 93. Balancing contractor shall set all air quantity limits, and shall not rely on any factory calibration. Report air quantity as measured by the air terminals velocity pressure pick up, in addition to pitot traverses and outlet readings.

END OF SECTION 233600

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 26 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Related Sections: Refer to all sections in Division 23. Refer to Division 26 and 28 specification sections and Division 26 and 28 drawings.

C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY:

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26 and Division 28. It expands and supplements the requirements specified in sections of Division 1 through 23.

1.3 ELECTRICAL INSTALLATIONS:

A. Drawings are diagrammatic in character and do not necessarily indicate every required conduit, box, fitting, etc.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.

D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

E. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

F. Before any work is begun, determine that equipment will properly fit the space and that conduit can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.

G. Verify all dimensions by field measurements.

H. Arrange for chases, slots, and openings in other building components to accommodate electrical installations.

I. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring an access path for positioning prior to closing-in the building or space.

J. Where mounting heights are not detailed or dimensioned, install electrical conduits, boxes, and overhead equipment to provide the maximum headroom possible. In general, keep installations tight to structure.

K. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components as much as practical, and connect equipment for ease of disconnecting and removal with minimum of interference with other installations.

L. Make allowance for expansion and contraction for all building electrical components and conduit systems that are subject to such.

M. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset and coordinate any systems as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

N. In general, all conduit systems shall be routed as high as possible. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

P. Coordinate the installation of electrical materials and equipment above and below ceilings with suspension system, luminaires and other building components. Ductwork and piping shall not be installed above electrical panelboards, switchboards, motor control centers, and transformers.

1.4 COORDINATION:

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, hangers, control devices, lighting, low voltage equipment, cable tray, conduit, transformers, disconnects, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and

manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Fire Alarm Contractor shall provide shop drawings to other Contractors as required.
2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 23 and Division 26 Contractors and shall furnish the same information involving control devices to the appropriate Contractor.
3. Automatic Doors and controls, Elevators and other building access equipment shall have cut sheets reviewed and shall furnish the same information to the appropriate Contractor.

C. Coordination Drawings:

1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.
2. Prepare and submit a set of coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare 11”x17” or 24”x36” / 30”x42” drawings to an accurate scale of 1/4"=1'-0" or larger. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment. Indicate movement and positioning of large equipment into the building during construction.
3. Coordination drawings are informational submittals. Submit coordination drawings to Engineer for information only to document proper coordination of all portions of work and that coordination issues have been identified and resolved prior to submitting to the Engineer and prior to commencing construction in each affected area. The review of the coordination drawings by the Engineer does not constitute a relief of responsibility of the Contractor or a change to the contract documents. The Contractor shall have sole responsibility in developing a fully coordinated and integrated ceiling cavity.
4. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the Work.
5. . Identification of space problems without solutions is not acceptable. Only areas clearly identified will be reviewed.
6. All coordination drawings shall be 3D, with provision for collision check. The contractor is responsible for obtaining the architectural and structural files in 3D. All 3D drawing development, collision check, coordination, etc. shall be included as part of the Contractors base bid.
7. Prepare coordination drawings and other Shop Drawings at a suitable scale, showing the required dimension. In addition to the mentioned areas and systems above, also submit specific equipment installations, including, but not limited to the following:

    a. Pad mounted and/or dry type transformers
    b. Switchboards and panelboards
    c. Equipment connections
    d. Control panels
    e. Circuit and motor disconnects
    f. Feeder conduits

8. CADD Drawings: Electronic AutoCAD drawings are available for purchase by the Contractor from the Engineer. Contact Engineer for further information in acquiring

CADD drawings. The Engineers Construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.

9. Wiring Diagrams: Provide wiring diagrams indicating: field installed electrical power; control wiring; cabling layouts; overcurrent protective devices; equipment, and equipment connections.

D. Existing Conditions:

1. Contractor shall carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing Coordination drawings.
2. Contractor shall be responsible for showing all existing conditions on the coordination drawings.
3. Provide proper coordination of electrical work with existing conditions.
4. Contactor shall report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains.
4. Plumbing vent piping.
5. Low pressure ductwork and air devices.
6. Electrical and communication conduits, raceways and cable tray.
7. Domestic hot and cold water.
8. Hydronic piping.
9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
10. DDC control wiring and other low voltage systems.
11. Fire alarm systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided, including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

F. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR:

A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Temporary Facilities.
2. Utility Company Coordination details.
3. Final coordinated distribution systems within the ceiling cavity.
4. Any system not fully detailed.
5. Fire alarm shop drawings.
6. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
7. Seismic restraint systems.

1.7 PROJECT CONDITIONS:

A. The contractor shall be required to attend a pre-bid walk-thru if required and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

B. Field verify all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections.

G. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, at a minimum one week in advance.

H. Minimize disruptions to operation of electrical systems in occupied areas.

1.8 SAFETY:

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

A. Refer to Division 1.

B. Execute and inspect all work in accordance with Underwriters Laboratories (UL), and all local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the more stringent requirement shall be followed. Follow application sections and requirements and testing procedures of NFPA, IEEE, NEMA, CBM, ANSI, NECA, ICEA, NETA, and IETA.

C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

D. Energy Codes: All equipment and installations shall conform to Federal, State, and local Energy Conservation Standards.

E. The handling, removal and disposal of regulated liquids or other materials shall be in accordance with U.S. EPA, state and local regulations.

F. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.

G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

H. All material used on this project shall be UL listed and labeled and be acceptable to the authority having jurisdiction as suitable for the use intended.

1.11 PERMITS AND FEES:

A. Refer to Division 1.

B. Contractor shall pay all fees required for connection to municipal and public utility facilities.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS:

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

B. All electrical and fire alarm systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the responsibility of the contractor.

1.13 TEMPORARY FACILITIES:

A. Light, Heat, Power, Etc. Responsibility for providing temporary electricity, heat and other facilities shall be as identified in these specifications, as shown on the drawings and as specified in Division 1.

B. Building distribution equipment and devices (existing or new) shall not be used without written permission of the Owner. If used for temporary power, the equipment shall be properly maintained and any damage resulting from use shall be repaired by the Contractor. The guarantee period for new equipment shall not begin until the equipment is turned over to the Owner.

C. If AC power systems or their backup systems serving telecommunications, computer equipment, or their associated HVAC equipment and controls are taken out of service, for any reason, the Contractor shall be responsible for providing temporary systems during the period when the AC power systems or their backup systems are out of service. The Contractor shall be responsible for providing temporary power to all loads being interrupted.

1.14 SUBMITTALS:

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other i.e. submit coordination and short circuit study prior to or together with gear, overcurrent protection devices, ATS, etc.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.

4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Subcontractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:

    a. Product
    b. Plan Code (if applicable)
    c. Specification Section
    d. Manufacturer and Model Number

7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed first in the specifications or on the drawings are the basis of design and are provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the first names, the cost of any changes in construction required by their use shall be borne by this Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards

D. Contractor Review: Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed unless written prior approval is obtained by the Contractor.

E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive product data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the ELECTRICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 26 Section.

F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes

2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

J. If more than two submittals (either for product data, shop drawings, record drawings, test reports, or O&M's are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."

L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

M. Submit letters certifying compliance with ANSI standards for medium or high voltage gear. These letters shall be signed by a corporate officer and shall list applicable standards. Letters signed by local representatives will not be acceptable.

N. Submit proposed changes to electrical room or other equipment room layouts when revised from contract documents prior to installation.

O. Mark submittals with designations as shown on the drawings and identify as required by Specification Sections. Identification shall contain the information as required in details and each label shall be submitted in list form with disconnects, MCC's, panelboards, switchboards, overcurrent protection devices and utilization equipment.

1.15 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

A. Product Listing:

1. Prepare listing of major electrical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect

   a. Provide all information requested.

2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
3. When two or more items of same material or equipment are required (lighting, wiring devices, switchgear, panelboards, protective devices, etc.) they shall be of the same

manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials steel bar stock, welding rods, solder, fasteners, except as otherwise indicated.

a. Provide products which are compatible within systems and other connected items.

4. For conduit, wire and fittings, the Contractor shall select a prime and alternate manufacturer from the list of acceptable manufacturers provided in the appropriate sections of this Division. The prime and alternate manufacturers shall be identified in the product listing. The contractor shall make every effort to use the prime manufacturer for the entire project. If products from this manufacturer are unavailable, the Contractor shall use the listed alternate with the following provisions.

   a. Wire: All wire placed in a single conduit or installed in multiple conduits making up parallel feeders shall be of the same manufacturer.
   b. Conduit and Fittings: All conduits and fittings installed exposed within the same room or immediate area shall be of the same manufacturer.

B. Schedule of Values

1. Provide Preliminary Schedule of Values to Engineer with product data submittal within four (4) weeks from award of contract to successful bidder. Provide according to the following descriptions:

   a. General Construction (total)
   b. Demolition
   c. Service/Distribution
   d. Lighting - Interior
   e. Lighting – Exterior
   f. Lighting Controls
   g. Basic Materials/Devices/Equipment Connections (Mechanical)
   h. Fire Alarm (Material/Installation)
   i. Security

2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

   a. Sizes.
   b. Weights.
   c. Speeds.
   d. Capacities.
   e. Conduit and electrical connection sizes and locations.
   f. Statements of compliance with the required standards and regulations.
   g. Performance data.
   h. Manufacturer's specifications.
   i. Housing and proposed Finishes.

j. NEMA or other ratings that apply.

5. Checklist: Where identified in ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit a detailed checklist which acknowledges compliance or a reason for non-compliance to each of the specification requirements. Arrange the checklist according to the headings of each item identified in each specification (i.e. Shop Drawings, Wiring Diagrams, Product requirements, individual line items, etc.) Mark items as "N/A" where the item is not applicable.

D. Shop Drawings:

1. Shop Drawings are defined as electrical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Electrical Shop Drawings, except diagrams, to accurate scale, min 1/8”-1'-0", Electrical rooms shall be ¼”-1’-0” unless otherwise noted.
3. Shop drawings shall include:

a. Proposed equipment installations.
b. Electrical characteristics and connection requirements.
c. Clearance dimensions at critical locations.
d. Dimensions of spaces required for operation and maintenance.
e. Interfaces with other work, including structural support.
f. Elevations when necessary in areas with multiple pieces of equipment on common walls or to clarify incoming/exiting methods/clearances, etc.
g. Wall and floor penetrations.
h. Wiring diagrams shall showing all components, internal connecting wiring, and contractor connection requirements including terminal blocks/lugs, wire sizes, etc.

E. Coordination Drawings: See separate paragraph of this specification section.

F. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

G. Operation and Maintenance Data: See separate paragraph of this specification section.

H. Equipment Settings Report: Where identified in the ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit Equipment Settings Report for each device indicating final configurations and settings.

1. Provide report of settings, parameters, programing inputs and parameters, etc., installed at each piece of electrical equipment that allows adjustments to be made in the field and those set at the factory. The report shall be arranged by specification section and each piece of equipment broken out individually or by listing of equipment if the same settings are installed in multiple pieces of equipment.
2. In addition to the requirements above, include within this report any individual ground fault system settings; zone interlock operational settings; Arc Flash reduction schemes and levels; transfer switch settings including time delays and upstream protection device settings with copies of listed OCPD’s for each ATS; settings of monitoring equipment

including trip levels and alarm levels; Generator settings and parameters; UPS settings and parameters; relay settings; transformer tap settings; phase rotation documentation; lighting control settings with associated timer settings; electrical interlock and/or kirk key system descriptions; posted operational signage; and any other pertinent information.

3. Report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

I. Software Licenses: Provide documentation of ownership under the owner's corporate name (coordinate with owner's representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

J. Record Drawings: See separate paragraph of this specification section.

1.16 DELIVERY, STORAGE AND HANDLING:

A. Refer to the Division 1, Sections on Transportation and Handling and Storage and Protection.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage and weather.

Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.17 DEMOLITION/REMODEL WORK:

A. Refer to Division 1 Section on Summary of work for requirements on working in Owner-occupied areas of the existing building and Division 2 section on selective demolition. The following paragraphs supplement the requirements of other Divisions.

B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, conduits, boxes, and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.

C. The project involves renovation and remodel of the existing building. On the drawings, work may be denoted by showing items as bold or light line weight and certain renovation symbols are used. These indications and symbols are amplified as follows:

1. Bold Print (when used): Work included in this contract is denoted in bold print or darker line weight.
2. Light Print (when used): Work shown lightly indicates existing conditions to remain.

R = Existing item to be removed. Contractor shall remove the existing item and the associated existing wiring. Where the raceway serving the equipment is accessible (via removal of suspended ceiling, crawl space, etc.) the raceway shall also be removed. Where the removal of a raceway leaves visible evidence on an existing surface which is not being repaired or replaced by the General Contractor, this contractor shall repair the surface. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover-plate installed. Where the concealed raceway is uncovered by demolition performed by the General Contractor, the raceway shall be removed (or extended to new location if appropriate).

E =Existing item to remain, may necessitate removal and reinstallation to facilitate new work, maintain circuit continuity. Contractor shall perform the following function based upon the item to remain:

Luminaires - Remove only if required for new work and clean and reinstall.
Switches - Remove devices only if required for new work and clean and reinstall.
Receptacles - Remove devices only if required for new work and clean and reinstall.
Clock - Clean and reinstall.

ER = Existing item to remain, Replace device, maintain circuit continuity. Contractor shall perform the following function based upon the item to remain:

Luminaires - Clean and install new lamps.
Switches - Remove and replace with new in existing box.
Receptacles - Remove and replace with new in existing box.
Clock - Remove and replace with new in existing box.

RL = Existing item to be Relocated. Contractor shall remove the existing item, and store in a safe place. The existing item shall be relocated to the new position as called for on the drawings. At Contractor's option, the existing wiring may be extended (unused boxes shall be removed and conduit and wiring extended from nearest concealed box unless specifically noted otherwise), or new wiring may be run from the source. Based upon the item to be relocated, the Contractor shall perform the following function:

Luminaires - Clean and reinstall in new location.
Receptacles - Clean and reinstall in new location.
Clocks - Clean and reinstall in new location.

RR = Remove and Reinstall. Existing item to be Removed and Reinstalled to facilitate new work.

D. Existing equipment that is removed and not scheduled to be reused shall remain the property of the Owner and be delivered for disposition unless specifically indicated otherwise and shall be stored in a location designated by the Owner. Items which are removed and not wanted by the Owner shall become the property of the Contractor and shall be removed from the site.

E. Existing equipment that is removed and is to be reused shall be cleaned, serviced and operable before being reinstalled.

F. Revise panelboard schedules to reflect removal or relocation of equipment. Circuit integrity of equipment in adjacent areas shall be left intact.

G. Where remodeling interferes with existing circuits and equipment which are not to be removed, such circuits and equipment shall be reworked and relocated as required to complete the project.

H. The Contractor shall remove all distribution equipment, conductors, etc., which are indicated to be removed or which must be removed to accommodate demolition. Equipment to be removed may require reworking conduit and wiring in order to maintain service to other equipment.

I. Where remodeling interferes with circuits serving areas outside of the project or phase limits or which are remodeled in later phases of the project, circuits shall be reworked or temporary circuits provided as required.

J. Existing equipment and circuiting shown are based on field surveys and/or Owner furnished drawings. The Contractor shall verify conditions as they exist with necessary adjustments being made to the drawing information.

K. Coordinate the routing of all conduits with the existing mechanical and plumbing systems in order to avoid conflicts with ducts, pipes, etc. Where existing electrical boxes, conduit, or equipment interfere with installation of new ducts, plumbing, walls, soffits, luminaires, outlets, etc., the Contractor shall resolve the conflict with the appropriate trade.

L. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated on the drawings or allowed under the appropriate section of the specifications.

M. Electrical Outages: Electrical outages must be held to a minimum. The Contractor shall submit a Method of Procedure (MOP) for each outage to the Owner, detailing the reasons for the outage, areas affected, sequence of procedures to accomplish work, estimated maximum length of time along with the date and time of day outage will occur. The Contractor shall meet with the Owner to set a schedule and date for the outage based on the MOP. Due to the critical implications of power outages, the Owner may direct the Contractor as to the time of day or night and date an outage may take place.

    1. The Contractor will be responsible for providing temporary power required for the duration of the outages. The required outages to connect and disconnect the temporary power will require a MOP as described above.
    2. Log each approved and implemented MOP and submit with O&M Manuals.

N. PCB Ballasts: PCB type ballasts may be present in existing luminaires. If PCB ballasts are discovered by the Contractor, report such occurrence to the Owner immediately. The Contractor shall remove and dispose of PCB type ballasts at an E.P.A. (Environmental Protection Agency) approved site in the prescribed manner acceptable to the EPA. The Contractor shall pay all fees associated with this work.

O. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken. Hazardous material removed is not a part of the work to be done under this Division.

P. Lamp Disposal: Contractor is responsible for sending removed lamps to be recycled. The Contractor should ensure the recycling agency meets RCRA and CERCLA regulations. Provide certificate of compliance in O&M Manuals.

Q. On Site Metering: When called for in the specifications or on the drawings, the Contractor shall meter the points indicated for a period of 30 days prior to start of construction to verify existing load. Meter shall record voltage; amperage; KVA; and Power Factor for each phase and sum of the phases. The meter shall continually average the power demand over maximum 15 minute intervals as required by NEC 220.87. Compile a metering summary report and deliver results to engineer after 7 days and after 30 days. Verify existing loads at and downstream of the metering location and provide list to engineer of what loads are not on during the 30 day metering and the reason why. Organize list by equipment name. If any loads have been removed or permanently abandoned, Turn circuit breaker off and relabel as SPARE.

1.18 CUTTING AND PATCHING:

A. Cutting and patching of electrical equipment, components, and materials may be required for removal and legal disposal of selected materials, components, and equipment. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

B. Refer to the Division 1 Section covering cutting and patching for general requirements.

C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.

E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of electrical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work;
2. Remove and replace defective Work;
3. Remove and replace Work not conforming to requirements of the Contract Documents;
4. Remove samples of installed Work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

G. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of conductors, conduit, luminaires, boxes, devices and other electrical items made obsolete by the new Work.

H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

J. Locate, identify, and protect electrical services passing through remodel or demolition area and serving other areas required to be maintained operational.

K. When coring is required or identified, an x-ray of the area is to be taken prior to the performance of the work operation. X-ray work requires an MOP and protection.

1.19 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough in requirements.

C. Work through all coordination before rough-in begins.

1.20 ACCESSIBILITY:

A. Install equipment and materials to provide required code clearances and access for servicing and maintenance. Coordinate the final location with piping, ducts, and equipment of other trades to insure proper access for all trades. Coordinate locations of concealed equipment, disconnects, and boxes with access panels and doors. Allow ample space for removal of parts, fuses, lamps, etc. that require replacement or servicing.

B. Extend all conduits so that junction and pull boxes are in accessible locations.

C. Provide access panel or doors where equipment or boxes are concealed behind finished surfaces.

D. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and requirements.

E. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

F. Furnish doors to trades performing work in which they are to be built, in ample time for building in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

G. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

H. Access doors in fire rated walls and ceilings shall have equivalent U.L. label and fire rating.

1.21 TESTING:

A. Submit test reports as outlined in Division 1 Sections on Quality Control Services and each Division 26 Section.

B. Testing as required by these specifications shall pertain to all equipment, wiring, devices, etc. installed under this contract and being reused.

C. General Scope:

1. Perform all tests and operational checks to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
2. The tests and operational checks shall determine the suitability for energization.
3. Schedule tests and give a minimum of two weeks advance notice to the Architect/Engineer. Reschedule testing for Owner convenience if required.

D. Test Report: Submit the completed report to the Architect/Engineer no later than fifteen (15) days after completion of test unless directed otherwise. The test report shall be bound and its contents certified. A final compilation of all Test Reports shall be submitted with the Testing and Equipment Settings Report (Refer to Operation and Maintenance Data paragraphs).

E. Each test report shall include the following:

1. Project information including: Building, name, address, date, and other pertinent information.
2. List of equipment tested.
3. Description of test.
4. List of test equipment used and calibration date.
5. Baseline, acceptable, or published target value for test with code or standard reference indicating where value was derived.
6. Test results that summarize all measured values with baseline values.
7. Conclusions and recommendations.
8. Appendix, including appropriate test forms that show all measured values.

F. Failure to Meet Test:

1. Any system material or workmanship which is found defective on the basis of performance tests shall be reported directly to the Architect/Engineer.
2. All failed tests shall be sent immediately by email to Architect/Engineer with proposed corrective action and proposed re-test date and time.
3. Contractor shall replace the defective material or equipment as necessary, and have test repeated until test proves satisfactory without additional cost to the Owner.

G. The testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:

1. Field Instruments: 6 months
2. Laboratory Instruments: 12 months
3. Leased specialty equipment: 12 months. (Where accuracy is guaranteed by lessor
4. Dated calibration labels shall be visible on all test equipment.

H. Independent Testing Agency:

1. The tests and/or operational checks indicated hereinafter in these Specifications shall be performed by a recognized independent testing agency engaged and paid for by the Contractor.
2. The testing agency shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the National Electric Testing Association constitutes proof of meeting such criteria.
3. The testing agency shall be responsible for implementing all final settings and adjustments on protective devices in accordance with Owner's specified values.
4. Testing Agencies: Subject to compliance with requirements and qualifications, the following are accepted agencies:

    a. Emerson
    b. Grounded Technologies, Inc.
    c. ABM Electrical Power Services

5. Independent Testing Agency requirements shall apply to the following Division 26 sections:

    a. Electrical Power Monitoring and Control
    b. Lighting Control Devices
    c. Secondary Unit Substations
    d. Low Voltage Transformers
    e. Low Voltage Circuit Protective Devices
    f. Ground Fault Protection Systems
    g. Surge Protection Devices

6. All work described in each section under field quality control shall be accomplished by the Independent Testing Agency.

1.22 EXCAVATING AND BACKFILLING:

A. General:

1. Provide all necessary excavation and backfill for installation of electrical work in accordance with Division 2.
2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring." Follow specifications of Division 26 as they refer specifically to the electrical work.

B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Prior to starting excavation, brief employees on marking and color codes and train employees on excavation and safety procedures for Utilities including electrical lines and natural gas lines. When excavation approaches electrical or gas lines, expose lines by carefully probing and hand digging.

C. Trenching:

1. Provide all necessary pumping, cribbing and shoring.
2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest electrical work. Install conduits with a minimum of 6 inches (or as identified on the drawings) clearance between them when located in same trench.

3. Dig trenches to depth, width, configuration, and grade appropriate to the materials being installed. Dig trenches to 6 inches below the level of the bottom of the material to be installed. Install 6 inches bed of sand, pea gravel, or squeegee, mechanically tamp to provide a firm bed, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal protrusions.

D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be accepted by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

1. Provide warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.

a. Tape shall have magnetic strip and be used for exterior underground system only.

E. Trench Backfill

1. Backfill to 4 inches above top of conduits with sand, the same as used for conduit bed, compact properly.
2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.

F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at contractor's expense.

G. This contractor shall repair and pay for any damage to finished surfaces.

H. Backfill near manholes or hand holes using sand, installing it in 6 inch layers to 4 inches above the shallowest conduit. Use suitable excavated material to complete the backfill, installed in 6 inch layers and mechanically compacted to seal against water infiltration. Compact to 95% below paving and slabs and 90% elsewhere.

I. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

1.23 NAMEPLATE DATA:

A. Provide equipment with permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Install equipment so that nameplate is readily visible.

B. Phase Rotation

1. New Building: Provide clockwise phase rotation on this project. Provide a label at service entrance main disconnect and the generator tap box indicating phase rotation for the building.

1.24 CLEANING:

A. Refer to the Division 1 Section on project closeout or final cleaning for general requirements for final cleaning.

B. Clean all luminaires, lamps and lenses per manufacturer's recommendations prior to final acceptance. Replace all inoperative lamps.

1.25 RECORD DOCUMENTS:

A. Refer to the Division 1 Section on Project Closeout or Project Record Documents for requirements. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; concealed control system devices, and any other relevant deviations from the Contract Documents.

D. Mark shop drawings to indicate approved substitutions; Addenda; Change Orders; actual equipment and materials used.

E. Schedules:

1. Mark luminaire schedule on drawings to indicate manufacturer and complete catalog numbers of installed equipment.
2. Mark schedules including panelboard, switchboard, motor control center, mechanical, kitchen and similar equipment schedules on drawings to indicate installed equipment and materials used, and any deviations or revisions to electrical load data and calculations.

F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme.

1. Red shall indicate new items, deviations and routing.
2. Green shall indicate items removed or deleted.
3. Blue shall be used for relevant notes and descriptions.

G. At the completion of the project, obtain from the Architect a complete set of the Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit marked up and completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

I. One full size set of record drawing one line diagrams shall be posted in the electrical room and one half size set of the remaining electrical record drawings shall be bound with 3 Hole inserts and plastic cover and stored in the electrical room.

1.26 OPERATION AND MAINTENANCE DATA:

A. Refer to the Division 1 Section on project closeout or operation and maintenance data for procedures and requirements for preparation and submittal of maintenance manuals.

B. No later than four (4) weeks prior to the completion of the project provide complete set of operating and maintenance manuals, or as specified in Sections of Division 1 (whichever is more stringent). Operation and Maintenance Data shall be submitted in electronic format.

C. Operation and Maintenance Data: Submit operation and maintenance data in maintenance manual in accordance with requirements of applicable Division 26 Sections and Division 1. Provide Operating and Maintenance Instructions in electronic format covering all equipment furnished. Manuals shall include all information required below, as indicated in each Division 26 Section, and the following for each piece of equipment:

1. The job name and address, contractor's name, address, and phone number, and each subcontractor's name, address, and phone number shall be identified at the front of the electronic submittal.
2. Name, address and telephone number to be contacted of the local authorized service organization/company and individual to be contacted for service and maintenance for each item of equipment.
3. Submit operation and maintenance data, schedule of recommended service and parts lists for all materials and products specified and intended for installation. Include description of function, normal operating characteristics and limitations, fuse curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
4. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
5. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
6. Servicing instructions and lubrication charts and schedules.
7. Manufacturer's service manuals for all electrical equipment provided under this contract.
8. Complete equipment and protection wiring diagrams. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
9. Equipment identification numbers and adjustment clearly indicated for each piece of equipment.
10. Electrical System and Equipment Warranties.
11. Provide manuals tabbed and divided into major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
12. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.
13. Equipment Testing Report including all test reports and Equipment Settings Report indicating final configurations and settings.

D. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, settings reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.27 PROJECT CLOSEOUT LIST:

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

1. The contractor shall be responsible for providing the items listed on the Electrical Submittal Checklist prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements (Checklist is located at the end of this section.)
2. Final payment will not be authorized until all items on the final punch list have been complete.

1.28 WARRANTIES:

A. Refer to the Division 1 Section on Warranties and Bonds for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In no case shall the warranty for the total electrical system be less than one year from date of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 26, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item. Information to include product or equipment description, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.29 CONSTRUCTION REQUIREMENTS:

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1. Up to date record drawings.
2. Addenda
3. Change Orders
4. Submittals
5. Site observation reports with current status of all action items.
6. Test results; including recorded values, procedures, and other findings.
7. Outage information.

1.30 EQUIPMENT HOUSEKEEPING PADS:

A. Provide 4" concrete housekeeping pad for all floor mounted equipment including, but not limited to: switchgear, switchboards, motor control centers, floor mounted distribution panelboards, floor mounted branch panelboards, floor mounted VFD’s and starter cabinets, and floor mounted dry type transformers. Fabricate pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 4" larger in both directions than the overall dimensions of the supported unit.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.

3. Place concrete and allow curing before installation of units. Use Portland cement that conforms to ASTM C 150, 54000-psi compressive strength, and normal weight aggregate.
4. Anchor housekeeping pads to slab using #3 rebar bent in “L” or “Z” shape 12 inch on center on each side of slab.

1.31 ELECTRICAL SUBMITTAL CHECKLIST:

A. Provide submittals including shop drawings, product data, product checklists, tests and reports, training, extra material, coordination drawings, record drawings, O&M manuals, device setting reports, and software licenses per the following schedule:

Division 26

C – Product Checklist; Q – Qualifications, CD – Coordination Drawings, RD - Record Drawings, D – Device Setting Report; S – Software License, W – Special Project Warranty

SPEC Section	TITLE	Requirements									
		Report Data		Test	Factory Test	Report	Factory Rep Supervision at Site	Training Req’d at Site	Extra Material	O&M	Other
		Shop Drawings	Product Data								
26 05 00	Common Work Results For Electrical										
	Electrical Coordination Drawings	X									
	Existing Conditions Survey Drawings	X									
	Utility Company Final Parameters, Measurements, Equipment, and Contacts	X	X	X		X				X	D
	Seismic Design Parameters per Local Authority	X	X			X				X	
	Temporary Facilities	X	X			X					
	Product Listing		X							X	C
	Preliminary Schedule Of Values					X					
	Final Schedule Of Values					X				X	
	Lamp disposal Certificates /PCB/Hazardous Material			X		X				X	
	Electrical On-Site Metering Reports			X		X				X	
	Tests/Independent Testing	X	X	X	X	X	X	X		X	D
	Preordered Equipment	X	X	X	X	X	X	X	X	X	C,D,S
	Completed/Signed MOP’s					X				X	
	Record Drawings including changes to existing Equip.	X								X	
	O&M Manuals	X	X	X	X	X			X	X	C,D,S
	Project Closeout List					X				X	
	Contractor/Equipment Warranties					X				X	
26 05 19	Low Voltage Electrical Power Conductors And Cables		X	X		X				X	

C – Product Checklist; Q – Qualifications, CD – Coordination Drawings, RD - Record Drawings, D – Device Setting Report; S – Software License, W – Special Project Warranty

SPEC Section	TITLE	Requirements									
		Report Data		Test	Factory Test	Report	Factory Rep Supervision at Site	Training Req'd at Site	Extra Material	O&M	Other
		Shop Drawings	Product Data								
26 05 29	Hangers And Supports For Electrical Systems	X	X							X	
26 05 33	Raceway And Boxes For Electrical Systems	X	X								CD, RD
	Electrical Metallic Tubing		X								CD, RD
	Flexible Metal Conduit		X								CD, RD
	Liquid-Tight Flexible Conduit		X								CD, RD
	Non-Metallic Conduit PVC		X								CD, RD
	Rigid Metal Conduit		X								CD, RD
	Surface Metal Raceway	X	X							X	CD, RD
	Wireways	X	X							X	CD, RD
26 05 34	Cabinets, Boxes & Fittings	X	X								CD, RD
26 05 37	Snow and Ice Melting Systems	X	X	X		X		X		X	D, CD, RD
26 05 53	Identification For Electrical Systems	X	X							X	
26 05 83	Wiring Connections	X	X	X							D
26 09 23	Lighting Control Devices	X	X	X		X	X	X	X	X	C CD, RD,,D,S
26 22 00	Low Voltage Transformers	X	X	X		X				X	C, CD, RD, D,S
26 24 16	Panelboards	X	X	X		X			X	X	CD, RD, D
26 27 26	Wiring Devices		X	X		X				X	
26 28 00	Low Voltage Circuit Protective Devices	X	X	X		X		X	X	X	C, D.S
26 28 19	Ground-Fault Protection	X	X	X		X		X		X	D
26 50 00	Lighting	X	X	X		X			X	X	
	Ballasts, LED's, Drivers	X	X	X		X				X	W
28 31 00	Fire Alarm Systems	X	X	X		X	X	X		X	C, Q, S

END SECTION 260500

SECTION 260519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.

C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's data on electrical wires, cables and connectors.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver wire and cable properly packaged in factory- fabricated type containers, or wound on NEMA-specified type wire and cable reels.

B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of wire, cable, and connector):

1. Wire and Cable:

    a. Southwire Company

2. Connectors:

    a. Ideal Industries, Inc.

2.2 WIRES AND CABLES:

A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed.

B. Conductors: Provide solid conductors and approved connectors for power, control, and lighting circuits 10 AWG and smaller. Provide stranded conductors for 8 AWG and larger.

C. Conductor Material: Use the following material for sizes indicated. Refer to Feeder Schedules on One Line Diagram.

1. Smaller than 200 amps and all grounding system conductors not sharing a common raceway: copper
2. 200 amps and Larger: 8000 Series electrical grade aluminum alloy 600v, except where another specific material is indicated.
3. Conductor sizes indicated on One line or schedules may be based on copper, see individual drawings for details. Sizes are based on Copper if no designation is shown, Sizes are based on Aluminum if Al is included in nomenclature. Modify conductor sizes as required to provide equivalent ampacity to indicated copper conductors. (A minus tolerance of 2 percent is permissible if ampacities remain above those shown in NEC Ampacity Tables.) Fully adapt and adjust the electrical system to size aluminum in lieu of copper. This includes, but is not limited to, the following actions:

    a. Where connecting to equipment whose manufacturer requires copper conductors connection, provide copper conductors from source, i.e. circuit breaker, disconnect, etc., and provide all necessary splices, splice boxes and other devices required to satisfy manufacturer requirements. Do not otherwise intermix copper and aluminum conductors.
    b. Increase conduit size and increase sizes of pull boxes, and junction boxes, and gutter space as required to accommodate larger aluminum conductors. Make structural, mechanical and other construction adjustments necessitated by these changes.
    c. Assure the pulling tension rating and support requirements of the aluminum conductors is adequate for wiring runs indicated.
    d. Assure that equipment at which aluminum conductors terminate is UL listed and manufacturer approved for use with aluminum and so labeled.
    e. Submit to the Architect/Engineer a record of actions taken in accordance with the above including marked-up project drawings, copies of manufacturer literature and communications and written conductor re-sizing calculations.
    f. Do not reduce raceway or enclosure sizes as part of the above adjustments.

4. Metal Clad Cable - Type MC: Sizes 12 AWG and 10 AWG, copper conductors with 600 volt thermoplastic insulation rated 90 degrees C, aluminum interlocked metal type covering. Fitting shall be steel with double grip saddle and locking nut.
5. Portable Cord:

a. Type SO: Sizes 12 AWG through 2 AWG, copper conductors with 600 volt thermoset insulation 0.1 resistant insulation.
b. Type G-GC: Sizes 1 AWG through 500 KCMIL, copper conductors with 600/2000 volt, 90 degrees C, ethylene-propylene insulation.

6. Cables: Provide the following types of cables in NEC approved locations and applications where permitted by the contract documents. Cables shall be U.L. listed and approved by the local building authority. All cables shall contain a green insulated equipment ground conductor of the same size as the neutral conductor.

2.3 CONNECTORS:

A. Description: Provide UL-type factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.

B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections when installed on bus bars. (Including phase, neutral and grounding conductors).

C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE:

A. Building Wire: Install all building wire in raceway regardless of location.

B. Metal Clad Cable:

1. Maximum of 6 feet unsupported length for connecting luminaires in accessible ceilings to the local junction box.
2. Maximum of 6 feet unsupported length for connecting luminaires in non-accessible ceilings to the local junction box.
3. May not be used for branch circuit home runs, feeders, motor feeder circuits.
4. Branch circuit conductors shall match color coding schedule within this specification section.

C. Portable Cord: Use for flexible pendant leads to luminaires, outlets, and equipment where indicated and in compliance with codes.

3.2 INSTALLATION OF WIRES AND CABLES:

A. General: Install electrical cables, wires and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.

D. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.

E. Keep conductor splices to minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control or fire alarm wiring. Connect unspliced wire to numbered terminal strips at each end.

F. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

G. Use splice and tap connectors which are compatible with conductor material.

H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A for copper and 486B for aluminum.

I. Support cables above accessible ceilings. Independent from the ceiling suspension system to support cables from structure, do not rest on ceiling tiles.

J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.

K. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type are not acceptable.

L. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.

M. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

N. Thoroughly tape the ends of spare conductors in boxes and cabinets.

O. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.

P. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.

Q. Branch circuits whose length from panel to first outlet exceeds 100 feet for 120 volt circuits or 175 feet for 277 volt circuit shall be #10 or larger, as required to comply with the National Electrical Code.

R. Parallel conductors shall be cut to the same length.

S. All splices in control panels, terminal junction boxes, low voltage control circuits, fire alarm, etc., conductors shall be on numbered terminal strip.

T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

U. Provide wire training, lacing, labeling, and terminal blocks as required in panelboards and all control cabinets including, but not limited to, lighting, transfer switch, fire alarm, and security cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.

1. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.

V. Color coding of switch legs, travelers, etc. shall be different and distinct from phase and neutral conductors. Where systems utilize two (2) different voltages, the color coding of switch legs, travelers, etc. shall be different and distinct for each voltage system.

3.3 FIELD QUALITY CONTROL:

A. Test installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders regardless of size and on all branch circuits with No. 4 AWG and larger conductors. The megger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be meggered after installation, and prior to termination. Submit test report.

B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.4 COLOR CODING SCHEDULE:

A. Match existing color coding present in building. Otherwise, color code secondary service, feeder, and branch circuit conductors as follows:

120/208 Volts	Phase	277/480 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

B. Conductors shall be solid color for entire length.

C. If solid color conductor insulation is not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:

1. Conductors 6 AWG and smaller shall be solid color for the entire length.
2. Conductors 4 AWG and larger shall have either solid color insulation as specified above for the entire length or be black with color coding at each termination and in each box or

enclosure. For a distance of 6 inches use half-lapped ¾ inch plastic tape in the above specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

3.5 METAL CLAD WIRING INSTALLATION:

A. The location of system components, including cable routing shown on the plans, are approximate. Use good judgment in their placement to eliminate all interference with ducts, piping, etc.

B. All cable routing shall be done in a neat and workmanlike manner, consistent with recognized good practice and in accordance with the manufacturer's instructions.

C. Route the cables along the grid system. Do not route cables diagonally or in any way which restricts removal of lay-in ceiling material.

D. Support cable on ceiling wires adjacent to each luminaire and at four foot intervals using clamp supports manufactured specifically for that purpose.

END OF SECTION 260519

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for each type of product specified.

1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Shop drawings indicating details of fabricated products and materials.

D. Engineered Design consisting of details and engineering analysis for supports for the following items:

1. Trapeze hangers for multiple conduit runs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Slotted Metal Angle and U-Channel Systems:

a. Allied Tube & Conduit
b. B-Line Systems, Inc.
c. Unistrut Diversified Products

2. Conduit Sealing Bushings:

a. O-Z/Gedney
b. Cooper Industries, Inc.
c. Killark Electric Mfg. Co.
d. Madison Equipment Co.
e. Raco, Inc.
f. Spring City Electrical Mfg. Co.
g. Thomas & Betts Corp.

2.2 COATINGS:

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES:

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 12-gage steel channels, with 9/16 inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

F. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. One-Hole Conduit Straps: For supporting 1 inch and smaller rigid metal conduit; galvanized steel.
2. Two-Hole Conduit Straps: For supporting 1 inch and larger rigid metal conduit, galvanized steel; ¾ inch strap width; and 2-1/8 inch between center of screw holes.

2.4 FABRICATED SUPPORTING DEVICES:

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
2. EMT, IMC, or Rigid Conduit.

2.5 FIRE SEALS:

A. Material: Fire stopping material shall be asbestos free, 100 percent intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.

B. Flame Spread: 25 or less, ASTM E84

C. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated "F" and "T" in accordance with ASTM E 814 or UL 1479. Rating periods shall conform to the following:
(F) 3 (T) 3 Time-rated floor or wall assemblies.

(F) 3 (T) 3 Openings between floor slabs and curtain wall.

D. Manufacturers: Subject to compliance with requirements, provide fire seals of the following:

1. 3M Company
2. STI
3. Tremco
4. Hilti

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Junction Box Supports: Comply with the NEC and the following requirement:

1. Use ¼" all-thread rod from structure to support junction boxes.

D. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Use #9 ceiling wire to support individual conduits up to 3/4inch with spring steel fasteners. Use of ceiling support wires is unacceptable.
5. Support parallel runs of horizontal raceways together on trapeze-type hangers. Use 3/8 inch diameter or larger threaded steel rods for support.
6. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼ inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing. For hanger rods supporting 1-1/2 inch or larger conduits provide 3/8 inch minimum threaded steel rods with pipe hangers.
7. Space supports for raceways in accordance with NEC. When there are 4 or more 2 inch conduits in a trapeze, supports shall be spaced 5 feet O.C.
8. In all runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
9. Threaded rod supports to have bottoms cut off at a maximum length equal to rod diameter below bottom nut.
10. Attachment of electrical supports to piping, ductwork, mechanical equipment or conduit is not allowed.

E. Conductor or Cable Supports: Comply with the NEC and the following requirements:

1. Support individual conductors or cables by separate clamps with rubber or plastic grommet, fasten using a non-metallic bolt and nut, and secure clamps to unistrut supports anchored to structure (multiple clamps may be secured to a single unistrut support). Individual conductors or cables may be served utilizing a vinyl or fiberglass clamp which shall be anchored to the structure.
2. Space supports as follows:

    a. Horizontal conductors not more than 3 feet o.c.
    b. Vertical conductors not more than 5 feet o.c.

3. Install simultaneously with installation of conductors.
4. HCF and MC Cable shall be supported by UL listed clip or clamp. Cable tie support is not acceptable.

F. Miscellaneous Supports: Support miscellaneous electrical components separately and as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

G. In overhead spaces, support metal boxes directly from the building structure via 1/4" minimum all-thread or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box. Supporting metal boxes utilizing ceiling type wire is not acceptable.

H. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for cable installations as required. Where sleeves through floors are installed, extend above finish floor. For sleeves through fire rated-wall or floor construction, apply UL-listed fire stopping sealant in gaps between sleeves and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 7 Section "Joint Sealers." See Architectural plans for location and extent of fire rated assemblies.

I. Conduit Seals: Install seals for conduit penetrations of exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

J. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts or self-drilling masonry anchors on concrete or solid masonry, cast in inserts on precast structures, spring-tension clamps on steel. Drilling of structural steel members is prohibited. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws, where authorized by the Owner and structural engineer. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Coordinate with the owner and structural engineer and obtain written prior approval of all work on concrete beams. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

K. Communication and Telephone Cable Supports: Use No. 9 ceiling wire to support individual or small bundles of cables run above accessible ceilings.

3.2 PERSONNEL PROTECTION:

A. Where U-channel systems, angles, brackets or other standard structural metal shapes are readily accessible and exposed to personnel, provide plastic or rubber end caps.

B. Where threaded rod supports are readily accessible and exposed to personnel, provide plastic or rubber end caps.

3.3 FIRE STOPPING LOCATIONS:

A. Preparation:

1. Coordination: Coordinate the work with other trades. Fire stopping materials at penetrations of insulated pipes and ducts can be applied after insulation is in place. If insulation is composed of combustible material, the thickness of fire stopping materials must be equivalent to that of the insulation. If the insulation is composed of non-combustible material, it may be considered as part of the penetrating item.
2. Surface Preparation: Surface Preparation to be in contact with fire stopping materials shall be free of dirt, grease, oil, loose material or other substances that may affect proper fitting or the required fire resistance.

B. Installation: Install fire stopping materials in accordance with the manufacturer's instructions.

C. Cleaning: After completion of fire stopping work in any area, equipment shall be reviewed and walls, ceilings and all other surfaces shall be cleaned of deposits of firestop materials.

D. Inspection: The architect may select and the Owner will pay an independent testing laboratory to examine fire stopped areas to ensure proper installation prior to concealing or enclosing the fire stopped areas.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND WIREWAY FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of raceway work is indicated by drawings and schedules. Provide complete conduit systems for all conductors unless otherwise specified.

B. Types of raceways specified in this section include the following:

1. Electrical metallic tubing (EMT).
2. Flexible metal conduit.
3. Liquid-tight flexible metal conduit.
4. Non-metallic Conduit and Ducts.
5. Rigid metal conduit (RGC).
6. Surface metal raceways.
7. Wireways.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.

C. Shop Drawings: Submit dimensioned drawings of surface metal raceway systems showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, if any. Show connections to electrical power panels and feeders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by the following:

1. Rigid Metal Conduit:

a. Allied

2. PVC Coated:

a. OCAL

3. EMT Conduit:

a. Allied

4. Non-Metallic Conduit:

a. Carlon

5. Steel Fittings:

a. Cooper

6. Conduit Bodies:

a. Thomas & Betts

7. Surface Metal Raceways:

a. Wiremold Co.
b. Airey Thompson Co.
c. B-Line Systems, Inc.
d. Isoduct Energy Systems
e. Square D. Co.
f. Mono-Systems, Inc.

8. Wireway:

a. Square D. Co.
b. Circle AW Products
c. Erickson Electric Equipment Co.
d. G.S. Metals Corp.
e. Hoffman Engineering Co.
f. Wadsworth Electric Mfg. Co., Inc.

2.2 METAL CONDUIT AND TUBING:

A. Rigid Galvanized Steel Conduit (RGC):

1. Conduit: Rigid steel, zinc-coated inside and outside, threaded ends.
2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

B. PVC Externally Coated Rigid Steel Conduit:

1. Conduit: Rigid steel zinc-coated with external coating of PVC.
2. Fittings: Threaded galvanized steel with external PVC coating, bushings shall have nylon insulated throat.

C. Electrical Metallic Tubing (EMT):

1. Conduit: Galvanized steel tubing.
2. Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for all other connections. Set-screw quick fit type for 2-1/2 inches and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.

D. Flexible Metal Conduit:

1. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, approved for grounding.
2. Fittings: Zinc coated, malleable iron. Straight connector shall be one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two piece body with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings shall be terminated with threaded bushings having nylon insulated throats.

E. Liquid-Tight Flexible Metal Conduit:

1. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, approved for grounding.
2. Fittings: Zinc coated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.

2.3 NON-METALLIC CONDUIT AND DUCTS:

A. Rigid Non-Metallic Conduit (RNC):

1. Conduit: Schedule 40 or 80 polyvinyl chloride (PVC), 90°C for direct burial or concrete encasement.
2. Fittings: Mate and match conduit type and material. Cement as recommended by manufacturer.

B. PVC and ABS Plastic Utilities Duct:

1. Conduit: Type 2 (EB) for encased burial in concrete; Type II (DB) for direct burial.
2. Fittings: Mate and match conduit type and material. Cement as recommended by manufacturer.

2.4 CONDUIT BODIES:

A. General: Types, shapes and sizes, as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use malleable iron conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.

C. Nonmetallic Conduit: Use nonmetallic conduit bodies.

2.5 WIREWAYS:

A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.

B. Lay-In Wireways: Construct lay-in wireways with hinged covers in accordance with UL 870 with components UL listed. Construct units to be capable of sealing cover in closed position with sealing wire.

1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature.
2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

C. Rain-tight Troughs: Construct in accordance with UL 870, with components UL listed.

1. Construction: 16-gauge galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14 gauge parts for 8" x 8" and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures. Do not use Gasketing that can rip or tear during installation, or would compromise rain-tight capability of the trough. Do not use cover screws that will protrude into the trough area and damage wire insulation.
2. Finish: Provide 14-gauge and 16-gauge galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

2.6 SURFACE METAL RACEWAYS:

A. General: Sizes and channels as indicated. Provide fittings that match and mate with raceway. All circuits either factory or field installed shall have a separate neutral conductor. Verify color with Architect/Engineer prior to order.

1. Surface Metal Raceway: Galvanized steel with Snap-on cover. Finish in manufacturer's standard prime coating suitable for field painting. Provide raceways of suitable size based on fill for circuits indicated on the drawings. Provide all necessary boxes, covers, extensions, fittings, etc. to form a complete assembly. Provide the quantity of receptacles, devices, compartment channels, etc. as indicated on drawings.

B. Boxes for Surface Raceways: Designed, manufactured and supplied by raceway manufacturer for use with specified raceway.

2.7 CONDUIT SIZES:

A. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus a parity sized equipment ground conductor and be subject to the following minimum sizes:

1. Rigid, Intermediate, and EMT Conduit: 3/4 inch for all runs except lighting switch legs, 277 volt lighting branch circuits, temperature control and fire alarm which may be ½ inch.

2. Flexible and Liquid-Tight Flexible Conduit: ½ inch for all runs.
3. MC Cable: 3/8 inch to under-counter luminaires, 1/2inch for all other runs.
4. Underground or Concrete Encased Nonmetallic Conduit: ¾ inch for all runs.
5. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining multiple home runs into a single conduit will not be permitted.

2.8 RACEWAY SEALING COMPOUND:

A. Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 deg. F (1 deg. C), withstands temperature of 300 deg. F (149 deg. C) without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials and the common metals.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 CONDUIT SCHEDULE:

A. Raceways in locations subject to mechanical injury: Rigid steel galvanized conduit or intermediate metal conduit.

B. Motor and equipment connections: PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors.

C. Raceways in all other areas shall be electrical metallic tubing unless otherwise noted.

D. Use flexible metal conduit inside movable partition wireways, from junction boxes to devices and between devices in casework, from outlet boxes to recessed luminaires, and for "fishing" of existing walls.

E. Rework or extensions of existing conduit shall include the use of similar materials to the existing conduit type unless otherwise noted.

3.3 INSTALLATION OF CONDUITS:

A. General: Install electrical raceways in accordance with manufacturer's written installation instruction, applicable requirements of NEC, and as follows:

1. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
2. Elevation of Raceway:

a. Where horizontal raceway is installed near water and steam piping, route raceway above piping and as close to structure as possible and practical.
b. Route raceway as close to structure as possible.

3. Complete installation of electrical raceways before starting installation of conductors within raceways.
4. Provide supports for raceways as specified elsewhere in Division 26.
5. Prevent foreign matter from entering raceways by using temporary closure protection.
6. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bend is not visible above the finished slab.
7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
8. Use raceway fittings that are types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints.
9. Run raceways parallel and perpendicular to building elements and other equipment with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
10. Raceways embedded in slabs: Not permitted on this project.
11. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.
12. Install vertical feeder conduits in exterior walls, core walls, or chase spaces. Do not install in interior wall partition areas.
13. Run exposed and parallel raceways together. Make bends in parallel runs from the same center line so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases provide field bends for parallel raceways.
14. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.
15. Tighten set screws of thread less fittings with suitable tool.
16. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. RGC and IMC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon insulated throats or threaded nylon bushings from 1/2" to 1". 1-1/4" and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panelboards, pull boxes, transformers, motor control centers, VFD's, etc.
17. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
18. Provide nylon pull string with printed footage indicators having not less than 200 pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull string. Identify with tags at each end the origin and destination of each empty conduit and indicate same on all empty or spare conduits on the as-built drawings.
19. Telephone and Signal System Raceways: Install raceways with maximum lengths at 100 feet and with a maximum of two, 90 degrees radiused bends or equivalent. Install 2' x 2' pull boxes where necessary to comply with these requirements. Install long sweep bends for all data and voice raceways.
20. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings where required by the NEC.

21. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded plugs flush with floor.
22. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate ground conductor across flexible connections. Where PVC conduit/couplings have been approved for exterior use and are exposed to sunlight, provide UV rated PVC coatings or protect with 2 coats of water based latex paint that is chemically compatible with the PVC products. Color selection shall be by Architect.
23. PVC externally coated rigid steel conduit: Patch all nicks and scrapes in PVC coating after installing conduit.
24. Where conduits are to be installed through structural framing members, the Contractor shall provide sleeves. The Architect/Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.
25. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.
26. Use of running threads for rigid or intermediate metallic conduit are not permitted. When threaded couplings cannot be used, provide 3 piece union or solid coupling.
27. Route conduit through roof openings for piping and ductwork where possible; otherwise, rout through jack with pitch pocket.
28. Conduits shall not cross pipe shafts or ventilation duct openings. Where conduits must penetrate air-tight spaces or plenums, seal around the conduit with a mastic acceptable to the Architect/Engineer.
29. Install an insulated ground conductor in all conduits.
30. Where individual conduits penetrate existing fire-rated walls and floors, pack void around conduit with fire rated insulation and seal opening around conduit with UL listed foamed silicone elastomer compound. Where conduits penetrate exterior walls, new floors, or roof, provide pipe sleeve one size larger than conduit, pack void around conduit with fire rated insulation, and seal opening around conduit with UL listed foam silicone elastomer compound.
31. Where conduit sleeves penetrate fire rated floors or walls for installation of system cables, MC cables, or modular wiring cables pack void around cables or empty sleeve with fire rated insulation and fill ends with fire-resistive compound. Seal opening around sleeve with UL listed foam silicone elastomer compound.
32. Use PVC-coated rigid steel or Fiberglass factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length. Use long sweep bends for wiring larger than 350 mcm.
33. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
34. Provide separate raceway systems for each of the following:

    a. Lighting
    b. Power Distribution
    c. Communications and Data
    d. Fire Alarm
    e. Temperature Control

35. Paint new exposed conduits to match wall finish color. Coordinate exact requirements with the Architect.
36. Provide rebar and tie downs for all conduits and conduit racks to be installed with concrete or slurry to prevent conduit “float”.

B. Install buried electrical line warnings per Division 26 section - “Electrical identification”.

C. Install labeling as required in Division 26 section - “Electrical Identification”.

3.4 INSTALLATION OF SURFACE RACEWAYS AND WIREWAYS:

A. Surface Raceways and Wireways: Mechanically assemble metal enclosures and raceways to form continuous electrical conductor and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

1. Where practicable, avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. Field bends of raceway sections are not permitted.
4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
5. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., are not permitted for use with surface raceway installations.
6. Install an insulated grounding conductor in all wireways and surface raceways. Bond grounding conductor to all wireways and surface raceways.
7. Paint new exposed surface metal raceway to match adjacent surfaces where raceway is installed in finished areas such as lobbies, corridors, and normally occupied spaces.
8. Surface raceways and wireways are acceptable only where specifically indicated on the drawings. The proposed use of surface raceways and wireways shall be submitted for review by the Engineer prior to installation.
9. Common wireways are not acceptable for convergence of multiple circuits unless specifically indicated on the drawings. The proposed use of a common wireway shall be submitted for review by the Engineer prior to installation.
10. The proposed use of wireways above or below panelboards, switchboards, motor control centers, and other electrical equipment shall be submitted along with a layout drawing for review by the Engineer prior to installation.

3.5 ADJUSTING AND CLEANING:

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt and construction debris.

END OF SECTION 260533

SECTION 260534 - CABINETS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this section include:

1. Outlet and device boxes
2. Pull and junction boxes
3. Cabinets
4. Hinged door enclosures

B. Conduit-body-type electrical enclosures and wiring fittings are specified in the Division 26 Section on Raceways.

1.2 DEFINITIONS:

A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.

B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.

C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.

E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or switches for controlling electrical circuits.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Submit product data for cabinets and enclosures with classification higher than NEMA 1.

C. Shop drawings for boxes, enclosures, and cabinets that are to be shop fabricated (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cabinets:

a. Hoffman Engineering Co.

2.2 CABINETS, BOXES, AND FITTINGS, GENERAL:

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers including blank covers for unused boxes, knockout closures for unused openings and other accessories required for the intended use. Provide gaskets for units in damp or wet locations. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

2.3 MATERIALS AND FINISHES:

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.

E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted Interior Finish: Where indicated, white baked enamel. Emergency system cabinets and boxes shall be red.

G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connecters.

2.4 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES:

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application. For multiple device installations, use multi-gang boxes. Sectional boxes are not permitted. Provide barrier for different voltage conductors in the same box.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be 4” square minimum with 2” depth minimum sheet steel with

stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior/plaster rings and fixture studs.

C. Malleable or Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.5 PULL AND JUNCTION BOXES:

A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

C. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

D. Malleable or Cast-Iron Boxes: Molded of iron alloy with gasketed cover and integral threaded conduit entrances.

2.6 CABINETS:

A. Comply with UL 50, "Electrical Cabinets and Boxes."

B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately ¾” larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inches.

D. Telephone cabinets wider than 48 inches may have sliding or removable doors. Provide ¾” thick plywood backboard painted matte white for Television, telephone and other communication cabinets.

E. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.7 STEEL ENCLOSURES WITH HINGED DOORS:

A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."

B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.

C. Doors: Hinged directly to cabinet and removable, with approximately ¾ inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation.

E. Enclosure: NEMA 1 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.8 CAST METAL ENCLOSURES WITH HINGED DOORS:

A. Copper free aluminum with bolted, hinged doors. Where used at hazardous (classified) locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions. Coordinate box locations with Architectural elements including casework, backsplash, door swings, etc.

B. Cap with Knock out closures all unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items securely in accordance with Division 26 Section on Supporting Devices.

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated. Size boxes to accommodate wire pulling, splices, taps, equipment connections and code compliance.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS:

A. Cabinets: Flush mounted, NEMA enclosure type 1 except as otherwise indicated.

B. Hinged Door Enclosures Indoor: NEMA type 1 enclosure except as indicated.

C. Hinged Door Enclosures Outdoors: NEMA Type 4. Install drip hood, factory tailored to individual units.

D. Hinged Door Enclosures in Corrosive Locations: NEMA type 4X nonmetallic enclosure.

E. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:

1. Interior Dry Locations: Sheet steel, NEMA Type 1.
2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
3. Wet Locations: NEMA Type 4 enclosures.

F. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.3 INSTALLATION OF OUTLET BOXES:

A. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.

B. Gasketed Boxes: At the following locations use malleable or cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.
2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
3. Where exposed to moisture laden atmosphere.
4. High traffic areas (surface installations).
5. Where indicated.

C. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles vertically, except above counter receptacles to be mounted horizontally. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Provide far side box supports, for electrical switch boxes installed on metal studs and provide stud to stud support for electrical receptacle boxes installed on metal studs.

D. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1-1/2 inches deep, minimum.

E. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

F. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

G. Concrete Boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6 inch depth.

H. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.

I. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.

3.4 INSTALLATION OF PULL AND JUNCTION BOXES:

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

Size of Largest Conductors in Box	Maximum no. of Conductors in Box
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

B. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.

C. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling. Where possible, locate pull and junction boxes above accessible ceilings in finished areas.

D. Flush in grade outdoor boxes shall be adequately supported against settling or tipping. Where heavy traffic or poor soil compaction exists, cast box in concrete base which provides 6” of cover around and under the box.

E. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES:

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor.

C. Set cabinets in finished spaces flush with walls.

3.6 GROUNDING:

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.7 CLEANING AND FINISH REPAIR:

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 260534

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Identification labeling for raceways, cables, and conductors.
2. Operational instruction signs.
3. Warning and caution signs.
4. Equipment labels and signs.

B. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 23.

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data for each type of product specified.

C. Submit schedule of identification nomenclature to be used for identification signs and labels for each piece of equipment including, but not be limited to, the following equipment types as specified in Division 26.

1. Cabinets and enclosures
2. Switchboards
3. Transformers
4. Panelboards
5. Disconnect switches
6. Circuit breakers and switches
7. Starters
8. Variable frequency drives
9. Fire alarm system panels and all ancillary cabinets and equipment
10. Lighting control cabinets including dimmer cabinets.

D. Submit samples of each color, lettering style and other graphic representation required for identification materials including samples of labels and signs.

1.3 QUALITY ASSURANCE:

A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ideal Industries, Inc.
2. LEM Products, Inc.
3. Markal Corp.
4. Panduit Corp.
5. W.H.Brady, Co.
6. 3M Company

2.2 ELECTRICAL IDENTIFICATION PRODUCTS:

A. Identify System Raceways with Painted Couplings & Connectors: Apply the following colors and submit paint sample colors prior to ordering:

1. Normal Power (208V/120V): White
2. Normal Power (277V): Orange:
3. Normal Power (480V): Yellow
4. Fire Alarm: OSHA Red
5. BMS/Temperature Control: Fluorescent Green
6. Ground: Safety Green
7. Data and Telephone System: Light Blue
8. Security: White (Verify with Owner)

B. Adhesive Marking Labels for Exposed Raceway and Busway: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Lighting, Power, HVAC, Communications, Control, Fire).

1. Label Size for Raceways and Busway: Kroy or Brother Labels 1 inch high by 12 inches long (minimum) with 5/8 inch minimum height letters.
2. Normal:

    a. 208V & 120V: Black letters on white background indicating source equipment designation, circuit number(s), and voltage.
    b. 277V: Black letters on orange background indicating source equipment designation, circuit number(s), and voltage.
    c. 480V: Black letters on yellow background indicating source equipment designation, circuit number(s), and voltage

3. Fire Alarm: White letters on red background indicating "FIRE ALARM".
4. Temperature Control: Black letters on blue background indicating "TEMP. CONTROL."
5. Ground: White or black letters on green background indicating "GROUND" and equipment and designation.
6. Building Alarms: Orange letters on white background indicating "BUILDING ALARMS."
7. Network Fiber: Black letters on white background indicating "NETWORK FIBER."
8. Where conduits enter or exit a panelboard, pull or junction box, switchboard, or other distribution equipment, conduit labels shall include circuit number in addition to feeder identification and voltage.

C. Provide colored Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width. Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved legend in white letters on black face for normal and white letters on red face for emergency, black letters on yellow face for UPS and punched for mechanical fasteners. Where required for ground connections, provide engraved legend in white letters on green face.

F. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws when screw ends do not protrude into working areas of equipment otherwise use number 10/32 stainless steel machine screws with nuts and flat and lock washers or rivets.

G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50 lb minimum tensile strength, and suitable for a temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color coding.

H. Adhesive Marking Tape for Device Cover Plates: 3/8 inch Kroy tape or Brother labels with 3/16 inch minimum height letters. Tape shall have black letters on clear background for normal and red letters on clear background for emergency. Embossed Dymo-Tape labels are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code. Clean surfaces to receive nameplates and labels and install nameplates and labels on front of equipment parallel with equipment/raceway/cable/wire/etc. lines.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Conduit Identification:

1. Adhesive Marking Labels: Provide adhesive marking labels for exposed raceway and busway and Raceway or Busway located above accessible ceilings. Install labels at //30 foot intervals. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned and read the same direction. Marking labels shall be located on conduits entering or leaving every junction box.

E. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system voltage and identity of contained circuits on outside of box cover. Color code shall be same as raceway systems. Use self-adhesive marking tape labels at exposed locations and indelible black marker at concealed boxes.

F. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker. Tape shall be 6 inches wide, 0.004 inches thick and 1750 psi minimum strength, trace wire run continuous length manhole to manhole and to equipment. Provide 3 feet slack rolled at each end.

1. Install line marker for underground wiring, both direct-buried and in raceway. Red for electrical, orange for phone and cable.

G. Circuit Identification: Tag or label conductors as follows:

1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
2. Multiple Circuits: Where multiple branch circuits, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

H. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

    a. Panelboards, electrical cabinets and enclosures.
    b. Access doors and panels for concealed electrical items.
    c. Motor starters.
    d. Pushbutton stations.
    e. Transformers.
    f. Fire alarm master station or control panel.

I. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

J. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.

K. Install labels at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 260553

SECTION 260583 - WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. From electrical source to motor starters.
2. From motor starters/motor controllers/VFD’s/etc. to motors.
3. To lighting equipment.
4. To transformers.
5. To grounds including earthing connections.
6. To master units of communication, signal, alarm, and video systems.
7. From push buttons to equipment requiring electrical connection.
8. Other connections as shown.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials. All mechanical and plumbing equipment shall be coordinated with unit nameplate information per the actual nameplate to be included on the equipment. As a minimum, information shall include: Operating Voltage; MCA (Min. circuit amperes); FLA (Full load amperes); MFS (Max. fuse size) or MOP (Max. overcurrent protection); and SCCR (Short Circuit Current Rating) and shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings. Bracing for equipment shall be provided at incoming terminals and as an option throughout the equipment for the available fault current or downstream equipment and devices shall be protected by current limiting fuses.

1.4 DEFINITIONS:

A. Load voltage wiring shall be defined as:

1. Conduit and wiring required to carry power to motors and other equipment or devices. Wiring from control devices to equipment that carry power to drive that equipment such as line voltage thermostats, etc., shall be included as load voltage wiring. Wiring that provides power to control panels, control transformers, control relays, time clocks, etc., shall also be included as load voltage wiring.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver electrical connection products wrapped in proper factory fabricated type containers.

B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.

C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects by one of the following:

1. Siemens

2.2 GENERAL:

A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Low Voltage Circuit Protective Devices, with OCPDs adapted to equipment connection installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.

B. Provide motor controllers that are horsepower rated to suit the motor controlled.

C. Contacts shall open each ungrounded connection to the motor. Contacts shall be NEMA rated, 75 degrees C.

D. Overload relays shall be ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which connected with appropriate adjustment for duty cycle and power factor correction supplied with the motor.

2.3 MATERIALS AND COMPONENTS:

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable

ties, solderless wire-nuts, disconnect, starter, contactor, relays, etc., and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:

1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division-26 section on Raceways.

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables, and connectors complying with Division-26 section on Wires and Cables.
2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes, ratings, and material of wires/cables which are supplying electrical power.
3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.
4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wire-nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.
5. Cord and Plug Connected Equipment: Where indicated, contractors shall provide a length of SO cord complete with a straight blade or twist-lock receptacle for connection of equipment. Cord and plug rating shall be suitable for the connected equipment load and rating of the branch circuit overcurrent protective device. Plug shall match receptacle configuration included on the plans and cord length shall be as required. Contractor shall connect cord to equipment.

2.4 MANUAL MOTOR STARTERS:

A. Manual starters shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Manual starters shall be complete with properly sized overload protection and neon pilot light. Manual starters shall be Square D Class 2510 or Allen-Bradley Bulletin 600 with stainless steel plates. Handles shall be lockable in open and closed position without modification.

B. Heater units in all manual motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.

2.5 CIRCUIT AND MOTOR DISCONNECT SWITCHES:

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. All equipment with maximum fuse size listed in nameplate shall have fusible disconnect switch provided. Provide NEMA 1 enclosure. For outdoor switches and switches indicated as weatherproof, provide NEMA 3R enclosures with rain-tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

B. Fusible Switches: Provide UL type "HD" 100 percent duty rated switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with

non-interchangeable feature suitable only for current limiting type fuses. All disconnect switches shall be fusible unless otherwise noted.

C. Non-fusible Disconnects: Provide UL type "HD" 100 percent duty rated switches of classes and current ratings as indicated.

D. Accessories:

1. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated or required.
2. Special Enclosure Material: Provide special enclosure material as follows for switches indicated:

   a. Stainless Steel Type 304: For NEMA Type 4.
   b. Molded Fiberglass Reinforced Plastic: For NEMA Type 4x.

3. Handles shall be lockable in open and closed position without modification.
4. Disconnect switches provided in the motor feeders between a VFD and the motor shall be provided with auxiliary contacts at the disconnect that de-energizes power to the VFD.

2.6 MOTOR STARTERS:

A. See Division 23 for Requirements

2.7 AUXILIARY CONTROL DEVICES:

1. Built in 120 volts control circuit transformer, fused from line side, where service exceeds 120 volts.
2. Ammeters, Voltmeters, and Frequency Meters: Panel type, 2-1/2 inch minimum size with 90 degree or 120 degree scale and plus or minus 2 percent accuracy. Where indicated. Current Sensors: Rated to suit application.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Furnish, set in place, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, plumbing and fire protection, elevator, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.

B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Maintain existing electrical service and feeders to equipment serving occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with torqueing values contained in UL's 486A.

I. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

J. Provide suitable strain relief clamps for cord connection to outlet boxes and equipment connection boxes.

K. Make wiring connections in control panel or in wiring compartment of pre-wired equipment and interconnecting wiring in accordance with manufacturer's instructions.

L. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated or per manufacturer's instructions.

M. Provide each motor with a fused disconnect switch for 3 phase motors and horsepower rated and/or thermal rated disconnect switch for single phase motors as shown on schedules or required. Coordinate with manufacturers of standalone, packaged and other equipment for factory installed and field installed motors and controllers.

N. Provide circuit and motor disconnect switches as indicated and where required by Code. Comply with switch manufacturers printed installation instructions. Install within sight of motors.

O. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.

P. Each branch circuit serving dedicated, isolated or emergency receptacles, multi-outlet assemblies or equipment connections shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit shall only be permitted where specifically noted.

Q. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

R. Provide 4" concrete housekeeping pads for new motor control sections and all floor mounted equipment.

3.3 FIELD QUALITY CONTROL:

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

3.4 EQUIPMENT CONNECTION SCHEDULES:

A. Mechanical Equipment:

1. Refer to Mechanical Equipment Schedule on the drawings.
2. It is suggested that all load voltage wiring shall be provided under Division 26.
3. Unless otherwise indicated, it is suggested that all equipment motors and control shall be furnished, set in place, and wired in accordance with the schedule contained herein. The exact furnishing and installation of the equipment is left to the Contractors involved. Contractor should note that the intent of this schedule is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ITEM	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
1. Mechanical Equipment Motors	M	M	--
2. Special Equipment (i.e., elevators, etc.)			
a. Motors	G	G	--
b. Magnetic Motor Starters	G	E*	--
c. Disconnect Switches	E	E	--
d. Thermal OL Switches			
e. Manual Operating Switches			

ITEM	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
3. Motor Starters, combination motor starter/disconnect and Variable Frequency Drives			
a. Automatically controlled, with or without HOA switches.	M	E*	M
b. Manually controlled.	M	E*	--
c. Starters integral with motor control center including control relays and transformers.	E	E	--
d. Combination Starter/Disconnects	M	E*	M
4. Pushbutton stations, pilot lights	M	E*	M
5. Disconnect switches, thermal overload switches, manual operating switches.	E	E*	M
6. Multi-speed switches	M	E*	M
7. Control relays, transformers.	M	M	M
8. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
9. Non-load voltage control items.	M	M	M
10. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.	M	M	M
11. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.	M	M	M**
12. Control circuit outlets	E	E	--
a. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
b. Non-load voltage control items.	M	M	M
c. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.	M	M	M
d. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.	M	M	M**
e. Control circuit outlets	E	E	--
13. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
14. Non-load voltage control items.	M	M	M
15. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.	M	M	M

ITEM	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
16. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.	M	M	M**
17. Control circuit outlets	E	E	--
18. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
19. Non-load voltage control items.	M	M	M
20. Fire protection controls (Including flow switches)	M	M	M**
21. Duct smoke detectors, including relays for fan shutdown.	E	M	M**
22. Temperature Control Panel	M	M	M
23. Interlocks	M	M	M

G = General, Division 13 or 14
M = Mechanical, Division 23
E = Electrical, Division 26

* For factory pre-wired equipment specified under other Divisions, all wiring within the equipment shall be by the manufacturer. All required field wiring between sections or other field connection details for power and/or control shall be clearly identified on shop drawings for contractor installation. Division 26 drawings show the provided electrical characteristics for equipment.

Manufacturer's equipment provided under other divisions which varies from what is shown on Division 26 drawings shall be the responsibility of the Contractor to complete and pay for any costs for those variations.

** Fire alarm system control modules and wiring from fire alarm contacts to fire alarm system shall be installed by Fire Alarm system installer and match other components of the system. Refer to Division 28. See details.

*** Integral control wiring under Electrical Division as manufacturer supplied equipment. Control wiring for automatic control portion under Mechanical Division.

END OF SECTION 260583

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of lighting control equipment work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, programmable controllers, data equipment, relays, switches, control wiring, and ancillary equipment.

B. Types of lighting control equipment specified in this section include the following:

1. Digital Programmable Lighting Controls
2. Occupancy Sensors
3. Photoelectric Relays

C. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings and wiring devices which are required in conjunction with lighting control equipment work.

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Shop Drawings: Submit layout drawings of lighting control equipment and components including, but not necessarily limited to, programmable controllers, manual override switches and stations, occupancy/vacancy sensors, dimmers, dimmer system components, daylight sensors, transceivers, printers, relays and other switches and equipment. Drawings shall show locations and associated addresses of all devices and equipment. In addition, show spatial relationship of lighting control equipment to other electrical equipment in proximity. List and verify that design sequence of operation and programmability including initial sensor/programed on/off times, override control settings, etc., have been provided for each lighting control zone.

C. Submit lists of Ballast/Driver and Lamp combinations compatible with dimmer systems, by manufacturer and catalog number.

D. Wiring Diagrams: Submit wiring diagrams for lighting control equipment and components showing control and interconnection wiring, include connections to equipment components and electrical power feeders. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed. Provide a voltage drop calculation for network cabling to verify EOL voltage compliance.

E. Coordination Drawings: Submit evidence that lighting controls and devices are compatible with connected monitoring and control devices. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

F. Agreement to Maintain: Prior to time of final acceptance, the Installer shall submit an agreement for continued service and maintenance of lighting control equipment, for Owner's

possible acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one year period with option for renewal of Agreement by Owner.

G. Maintenance Manuals: Ensure manual includes operating instructions in addition to instructions for maintenance of the system's software package.

H. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

I. Commissioning Report: Submit Preliminary and Final Commissioning Report for all Lighting Control Equipment. Preliminary report shall be submitted no later than 90 days of the date of receipt of the certificate of occupancy. Reports shall be organized and include information as required by the current edition of the IECC-International Energy Conservation Code.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with lighting control equipment work similar to that required for this project.

C. Agreement to Maintain: Engage Installer who is willing to execute with the Owner, required agreement for continued maintenance of lighting control equipment.

D. FCC Compliance: Comply with Part 68 of Federal Communications Commission Rules pertaining to telephone equipment registration by manufacturer.

1. Provide telephone equipment with FCC labels indicating applicable FCC registration and numbering of equipment.

E. Codes and Standards:

1. Energy Code Compliance: Meet the requirements of the current edition of the IECC-International Energy Conservation Code. In addition, meet any additional requirements of the Local AHJ-Authority Having Jurisdiction.
2. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction, installation of lighting control and communications equipment.
3. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.
4. UL Compliance: Comply with applicable requirements of UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide lighting control equipment and components which are UL-listed and labeled. Lighting control panels shall be UL 916 and UL 924 Listed.
5. NEMA Compliance: Comply with applicable requirements of NEMA's Std. Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)."
6. EIA Compliance: Comply with applicable requirements of Electronic Industries Association standards pertaining to telephone and electronic systems.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver lighting control equipment and components in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Electrically Held Relays: Equal to 5% of amount installed.
2. Occupancy/Vacancy Sensors: Equal to 5% of the amount installed for each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide lighting control equipment of one of the following (for each type and rating of equipment):

1. Digital programmable lighting controls:

a. Crestron (match existing system within facility)

2.2 DIGITAL PROGRAMMABLE LIGHTING CONTROLS:

A. General: Provide factory-fabricated lighting control equipment and ancillary components of sizes, types, ratings and electrical characteristics indicated; consisting of programmable controllers, data equipment, relays, switches, control wiring, interfaces to dimming systems, and interfaces to building management systems which comply with manufacturer's standard design, materials and components; and construct in accordance with published product information for duty indicated, and as required for a complete installation.

B. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.

C. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a programmable-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.

D. Programmable Lighting Controller Description: Programmable, unit with graphic display and programming of system status and to override relay status; and to display status of local override controls and diagnostic information.

1. Interoperability:

a. Controller shall be configured to connect to a BACnet-compliant network, resulting in extending control to any network-compliant devices such as occupancy/vacancy switches.
b. Mechanical Controls Interface: Where indicated, occupancy sensors within a control zone shall send occupied state or unoccupied state information to BAS, associated Network, or individual room equipment as identified by Mechanical Controls Contractor.
1) Provide all necessary interface components to allow the lighting control system and BAS/Network/Equipment to seamlessly communicate.

c. A/V System Interface: Where indicated, provide the necessary interface components and programming to allow override of the lighting control system by the A/V system within the specified control zone. The full operability of the lighting under normal conditions shall be maintained including dimming, switching, and color-changing.
1) All lighting within indicated control zone shall maintain required emergency operation while under A/V system override.
2) Contractor shall coordinate the communications protocol with the A/V system supplier and shall provide the necessary hardware and programming for a fully operation system.

2. System Memory: Nonvolatile. System shall reboot program and reset time automatically without errors after power outages up to 90 days' duration.
3. Software: Lighting control software shall be capable of linking switch inputs to relay outputs, retrieving links, viewing relay output status, controlling relay outputs, simulating switch inputs, setting device addresses, and assigning switch input and relay output modes.
4. Automatic Time Adjustment: System shall synchronize to real time through internet protocol, shall automatically adjust for leap year with manual time and date of adjustment selection, shall automatically adjust for daylight saving time with manual ON/OFF for this feature, and shall provide Time Controls utilizing 7 Day clock with minimum 7 different day times per week, and programmable auto Holiday “shutoff”.
5. Astronomic Control: Automatic adjustment of dawn and dusk switching based on exterior photoelectric sensor control.
6. Automatic battery backup shall provide power to maintain program and system clock operation for 3 days' minimum duration when power is off.
7. Flick Warning: Programmable momentary turnoff of lights shall warn that programmed shutoff will occur after a preset interval. Warning shall be repeated after a second preset interval before end of programmed override period.
8. Diagnostics: When system operates improperly, software shall initiate factory-programmed diagnosis of failure and display messages identifying problem and possible causes.
9. Automatic Control: System capable of activating building areas into user dictated pattern of ON-OFF array of relays, according to either weekly schedule divided into one-minute increments, or two one-day schedules.
10. Automatic Control of Local Override: Automatic control shall switch lighting off if lighting has been switched on by local override. Utilize “Flick Warning” where indicated.
11. Manual Controls: System capable of activating each lighting zone or single groups of relays ON-OFF with a momentary switch; Provide prioritization of manual controls.

12. Manual Lockout: System capable of selecting, activating and locking-in any lighting pattern from central controller, and locking-out manual and automatic commands.

E. Manual Switches and Plates

1. Switches: Provide momentary toggle type ON-OFF switches with spring return to center position; and as recommended by lighting systems manufacturer for services indicated. An integral pilot light shall indicate the status of circuit.
2. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

F. Relays: Provide relays for control of inductive loads of 20 amperes at 120-volts, 50 to 60 Hz, as recommended by lighting systems manufacturer for services indicated.

2.3 OCCUPANCY/VACANCY SENSORS:

A. Wall or ceiling-mounting, solid-state units with a separate relay unit.

1. Provide Dual Technology Devices unless otherwise shown. Spacing and coverage per the manufacturer's recommendations.
2. Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
4. Relay Unit: Dry contacts rated for 20-A ballast/driver load at 120- and 277-V ac.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

2.4 PHOTOELECTRIC SENSORS:

A. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photo-resistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Light-Level Monitoring Range: 10 to 1000 fc with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead-band adjustment.

B. Outdoor Photoelectric Switch: Solid-state, light-level sensor unit to detect changes in lighting levels that are perceived by the eye.

1. Light-Level Monitoring Range: 1.5 to 10 fc with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 30 second minimum to prevent cycling, with dead-band adjustment.
3. Surge Protection: Metal-oxide varistor, complying with IEEE requirements for Category A1 locations.

4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which lighting control equipment is to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.

B. Low voltage control wiring terminations shall be made within electrical boxes.

C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Interconnect lighting control equipment with building management system, after lighting equipment installation work has been completed and is operating properly. Define groups in the lighting control system to interface with the building management system as indicated on the temperature control matrix.

E. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and B.

F. Co-locate equipment as much as practical for ease of maintenance.

G. Provide hardwired connections to each device, controller, sensor, etc. for control connections.

3.3 GROUNDING:

A. Provide equipment grounding connections for lighting control equipment as indicated. Tighten connectors to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL:

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at

site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Testing and retesting at no cost to Owner.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust all field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing with commissioning report.

C. Perform the following field tests and inspections for each piece of equipment and each device and prepare test reports:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by facilities.

D. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values and submit settings list with Testing and Equipment Settings Report. Provide current licenses for software in O&M manuals.

E. Commissioning Report: Provide Commissioning services required to provide Preliminary and Final Commissioning Report for all Lighting Control Equipment. Preliminary report shall be submitted no later than 90 days of the date of receipt of the certificate of occupancy. Testing and Reports shall be organized and include information as required by the current edition of the IECC.

F. Testing and training shall be provided at times scheduled with the owner and may need to be done off hours.

3.5 PERSONNEL TRAINING:

A. Manufacturer's Field Service indicated above shall include Owner’s maintenance personnel.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software.

C. Provide extra scheduled time with owner to make corrections to the system to meet the functionality/time control requirements desired by the owner. Record any changes in the Testing and Equipment Settings Report and submit final documents.

END OF SECTION 260923

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.2 DEFINITIONS:

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Shop drawings from manufacturers of panelboards including dimensional data. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current rating of panelboard and circuit breakers.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

C. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.

D. Report of field tests and observations.

E. Panel schedules for installation in panelboards. Submit final versions after load balancing.

1.4 QUALITY ASSURANCE:

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Siemens

2.2 PANELBOARDS, GENERAL REQUIREMENTS:

A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Overcurrent Protective Devices, with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.

B. Enclosures: Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting, where indicated as such on the drawings. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

C. Front: Hinged trim type, secured to box with 1/4-20-large head slotted captive screws except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified. Provide fronts with hinged trim construction and door with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges on inner door, piano hinge on outer trim door, and door swings as indicated.

D. Directory Frame: Metal, mounted inside each panel door with card and clear plastic cover. Directory shall match panelboard configuration, i.e. top to bottom, left to right. Provide permanent panelboard labels for each circuit number.

E. Bus Material: Provide tin plated hard-drawn copper of 98 percent conductivity.

1. Provide alternate to provide tin-plated, high-strength, electrical grade aluminum alloy bus in lieu of copper.

F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductor’s bonded to box.

G. Provide lugs for incoming feeders and grounds compatible with bus and feeder material.

H. Provide minimum short circuit current ratings as indicated.

I. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS:

A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Double-Width Panels: Where more than 42 poles are indicated, provide two panelboards of equal dimensions and with individual fronts on each panelboard.

2.4 DISTRIBUTION PANELBOARDS:

A. Branch-Circuit Breakers: Where OCPDs are indicated to be circuit breakers, use bolt-on breakers except circuit breakers 225-ampere frame size and greater may be plug-in type where individual positive locking device requires mechanical release for removal.

2.5 IDENTIFICATION:

A. General: Refer to Division 26 Section on electrical identification for labeling materials.

B. UL nameplates shall be provided for all panelboards. Information shall include, but not be limited to, manufacturer, model number, serial number, plant or manufacturing location, ampere rating, voltage rating, wire and phase identification and bus short circuit bracing rating.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."

C. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.

D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub one 1 inch empty conduit from panel for each set of 3 spares or spaces into accessible ceiling space or space designated to be ceiling space in future. Stub one 1 inch empty conduits for each set of 3 spares or spaces into raised floor space or below slab other than slabs on grade.

G. Auxiliary Gutter: Install where two panels are vertically mounted. Use gutter for branch circuit wiring to lower panel.

H. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

I. Feeders to multiple section panelboards, from Sub-Feed Lugs or Feed-Through lugs shall match the feeders to the panelboard.

3.2 IDENTIFICATION:

A. Identify field-installed wiring and components and provide warning signs in accordance with Division 26 Section on electrical identification.

3.3 GROUNDING:

A. Connections: Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus indicated.

3.4 CONNECTIONS:

A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL:

A. Upon completing installation of the system, perform the following tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests of circuits.

B. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

C. Schedule tests with at least one week in advance notification.

D. Reports: Provide report written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

E. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.

F. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Verify that proper grounding bushings/bonding/ and panel enclosure bonding is complete.

6. Verify isolated neutral bar and neutral connections.

G. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses. Insulation resistance less than 100 megohms is not acceptable.
2. Ground resistance test on system and equipment ground connections.

3. Test main and sub-feed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."
   Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

3.6 CLEANING:

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Ground-fault circuit interrupters.
3. Switches.
4. Wall-plates.
5. Plugs and connectors.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.

C. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Samples of device plates for color selection and evaluation of technical features shall be submitted.

1.4 COORDINATION:

A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.

B. Cord and Plug sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Products shall be of the same manufacturer insofar as possible. Subject to compliance with requirements, provide wiring devices of one of the following:

1. Devices, Cover Plates, Accessories:

   a. Leviton Mfg. Co.

2. Weatherproof Receptacle Covers:

   a. Hubbell, Inc.

2.2 WIRING DEVICES:

A. Color selection shall be verified with Architect prior to ordering. Devices shall be. All receptacles and switches connected to circuits served from a generator system shall have a red face.

B. Receptacles:

1. All duplex, single, Ground Fault Interrupter (GFCI), and other special receptacles shall be minimum, specification grade commercial series, listed by Underwriter's Laboratories, UL 498 and Federal Specification FS W-C-596, 20 amp, nylon face and have a metal mounting strap with self-grounding and have a hex-head green grounding screw and be side and back wired. Each device shall bear the UL/FS Label. Meet NEMA standards for wiring devices including NEMA WD 1 for general requirements and NEMA WD 6 for dimensional standards.

   a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug-tail device connections are acceptable.

2. Convenience Receptacle Configuration: Duplex or Single as indicated on the drawings, Type 5-20R.
3. USB Charging: Where indicated with ‘USB’ on drawings, provide duplex receptacle with (2) built in 2.1 A USB charging ports.
4. Weather Resistant Receptacles: In addition to the above requirements all receptacles in damp and wet locations shall be WR (Weather Resistant) labeled.
5. Special Purpose Receptacle Configuration: straight blade or locking as indicated on drawings, black face.
6. Ground-Fault Interrupter Receptacles: Where indicated or required provide "local reset" auto monitoring “self test” ground-fault circuit interrupters. Provide unit capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943. Provide visual indication of lost protection.
7. Pendant Cord/Connector Devices: Matching, locking type, plug and plug receptacle body connector, NEMA l5-20P and L5-20R, heavy-duty grade.

a. Bodies: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
b. External Cable Grip: Woven wire mesh type made of high strength galvanized-steel wire strand and matched to cable diameter and with attached provision designed for the corresponding connector.

8. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.

a. Cord: Rubber-insulated, stranded copper conductors, with type-SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30% minimum.

Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.

C. Switches:

1. Wall Switches for Lighting Circuits: NEMA WD1 and WD-6; FS W-S-896E; AC quiet type specification grade commercial series listed by Underwriter's Laboratories with toggle handle, rated 20 amperes at 120-277 volts AC, unless noted otherwise. Mounting straps shall be metal and be equipped with a green hex-head ground screw. Each switch shall bear the UL/FS Label.

a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug Tail device connections are acceptable.
b. Pilot Light Type: Where indicated, provide Lighted handle lit when switch is "on."
c. Locator Type: Where indicated, and in mechanical rooms, electrical rooms, IT rooms, etc. switches shall be provided with continuously lighted handle. Switches in Hazardous (Classified) Locations: Comply with UL Standard 894, "Switches for Use in Hazardous (Classified) Locations."

2.3 WIRING DEVICE ACCESSORIES:

A. Verify color and type with Architect prior to ordering. Device color to match Wiring Device Color identified above. Verify location, height, mounting conditions, etc., of all devices with Architectural drawings prior to rough-in.

B. Wall-plates: Provide wall-plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Identify all wall plates used for receptacles with branch circuit number per requirements of section on Electrical Identification. Provide blank wall plates for all cable, data, telephone and junction and outlet boxes. Where cables are routed through the wall-plate, provide grommets in wall-plate openings to protect cables. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04" thick, type 302 satin finished stainless steel, smooth.
2. Material and Finish: 0.04" thick, type 302 satin finished stainless steel for use in unfinished areas, mechanical, and electrical rooms.
3. Gaskets: Resilient rubber or closed cell foam urethane.
4. Weather Proof, Exterior and other wet locations and where called out on the drawings as “WP”, provide weatherproof junction box with gaskets and cover.

a. "In Use" type: Cover shall be rated "while in use". Use low profile type covers with UV rated and resistant polycarbonate.
b. Outlet box hood shall be listed as "extra duty".

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall-plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.

G. Provide GFCI type outlets as required in NEC 210, including but not limited to: each above counter duplex receptacle shown within 6 feet-0 inches of sinks/lavatories; Bathrooms; Kitchens; Roof Tops; Outdoors; Indoor Wet locations; Locker Rooms; Shower Facilities; vending machines; etc. For above counter multi-outlet assemblies which do not contain duplex receptacles that can be replaced with GFCI devices, provide GFCI circuit breakers on the branch circuit(s) feeding the assembly. Where GFCI devices are required and/or shown but are not readily accessible when equipment is installed, i.e. vending machines, etc., provide blank face GFCI device and cover-plate ahead of inaccessible receptacles. Mount adjacent to equipment at switch height unless otherwise shown. Install individual GFCI devices at each location shown, feed through devices are only acceptable where specifically called for.

H. Receptacle Mounting: Mount device with front of device flush with the cover plate. Over the counter receptacles shall be mounted horizontally with ground to the right. Where switch and receptacles are mounted within one stud space align vertically. Vertically mounted receptacles shall be mounted with ground up.

I. Switch Mounting: Switches shall be ganged and within 18" of the door jam on the strike side of the door openings unless otherwise shown. Verify door swings with Architectural drawings prior to rough-in. Switches connected to the life safety system shall not be ganged with other switches. Switch and receptacle combinations shall be installed in 2 gang box where both are of the same voltage. provide separate boxes where different voltages are present.

3.2 PROTECTION OF WALLPLATES AND RECEPTACLES:

A. Upon installation of wall-plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING:

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.4 CLEANING:

A. Internally clean devices, device outlet boxes and enclosures. Replace stained, cracked, damaged or improperly painted wall plates or devices. Remove temporary markings of labels.

3.5 TESTING:

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained and prepare test reports. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

1. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems.
2. Tests for Convenience Receptacles:

    a. Line Voltage: Acceptable range is 114 to 126 V.
    b. Ground Impedance: Values of up to 2 ohms are acceptable.
    c. Polarity: Test for correct neutral conduct to neutral terminal connection.
    d. Using the test plug, verify that the device and its outlet box are securely mounted.
    e. GFCI Receptacles: Test for tripping values specified in UL 1436 and UL 943. Test with both local and remote fault simulations in accordance with manufacturing recommendations.

3. Test Instruments:

    a. Use instruments that comply with UL 1436.
    b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Correct Deficiencies and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace devices as required to bring system into compliance.
2. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Prepare a report that identifies enclosure, units, conductors and devices checked and describe results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 262726

SECTION 262800 - LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes overcurrent protective devices (OCPD's) rated 600 V and below and switching devices commonly used with them.

B. Panelboards, Switchboards, and Motor Control Centers: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 26 sections.

1.2 DEFINITIONS:

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

C. Provide Electrical system Arc Flash Study performed by a registered professional engineer in accordance with ANSI/IEEE Standards. Submit a full study with printed labels affixed to each piece of equipment. Include single line diagram with nodes corresponding to the system components, Arc Flash calculations identifying hazard levels, etc. Study shall include all utility systems, overcurrent devices, transformers, buses, generator systems, grounding systems. etc., which comprises the AC power system, Study shall be commissioned and paid for by the Contractor. Submit study with panelboard submittals.

D. Submit documentation of compliance with Code and Specification requirements for circuit protective devices including but not limited to SCCR, Listings for use with downstream breakers/fuses and equipment where required, Ground Fault protection; Arc Flash reduction for breakers above 1200A; Surge Protection; Metering; Relaying; etc.

1.4 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Each type of OCPD shall be the product of a single manufacturer.

1.5 EXTRA MATERIALS:

A. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.

PART 2 - PRODUCTS:

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cartridge Fuses:

a. Bussmann Div., Cooper Industries, Inc.
b. Littelfuse Inc.

2. Fusible Switches:

a. Siemens Energy & Automation, Inc.

3. Molded-Case Circuit Breakers:

a. Siemens Energy & Automation, Inc.

4. Combination Circuit Breaker and Ground Fault Circuit Interrupters:

a. Siemens Energy & Automation, Inc.

5. When mounting overcurrent protective devices in switchboards, panelboards, etc., provide equipment of same manufacturer as equipment into which they are being mounted.

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDS), GENERAL:

A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and also as individually enclosed and mounted single units.

B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

C. Where OCPD's are to be installed in existing panelboards, switchboards, and motor control centers, they shall be of the same manufacture and type as those existing in the equipment. If

this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.

D. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.

E. Ground Fault Protection: Distribution circuit breakers: provide integral, self-powered type with mechanical ground fault indicator, test function, adjustable pick-up current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated or required. Provide combination devices for branch circuit protection as follows; where shown or required provide 30 mA Ground Fault circuit breakers for each circuit feeding Electrical Heat Trace to protect from overheating and fire and 5 mA Ground Fault circuit breakers for each circuit feeding receptacles to protect personnel. Coordinate with manufacturer’s instructions.

2.3 CARTRIDGE FUSES:

A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. All fuses used for main, feeder, or branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled. Fuses used for supplementary protection (other than branch circuit protection) shall be as specified above or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.

C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.

D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.

E. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."

F. Class RK1 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."

G. Class J Low-Peak dual Element Fuse: UL 198C

2.4 NONFUSIBLE SWITCHES:

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.

B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the available.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

G. Contacts shall be NEMA rated 75 degrees C.

H. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.5 FUSIBLE SWITCHES:

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.

B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Fuse Clips: Rejection type.

G. Enclosure for Switchboard or Panel board Mounting: Suitable for panel mounting where indicated.

H. Enclosure for Independent Mounting: Provide NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

I. Contacts shall be NEMA rated 75 degrees C.

J. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.

K. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.6 MOLDED-CASE CIRCUIT BREAKERS:

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Provide bolt-in type, except breakers 225-ampere frame size and larger which may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.

D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 250 amperes or larger. Breakers 150 amperes and above shall have

adjustable trip selection for trip units. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.

F. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

G. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.

H. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

2.7 COMBINATION CIRCUIT BREAKERS AND GROUND FAULT CIRCUIT INTERRUPTERS:

A. General: UL 943 "Ground Fault Circuit Interrupters," arranged for sensing and tripping for ground fault current in addition to overcurrent and short-circuit current. Provide features as follows:

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2.8 CIRCUIT BREAKERS WITH SOLID-STATE TRIP DEVICES:

A. General: In addition to other requirements as listed, all breakers indicated on the drawings as GFI, all adjustable trip breakers, if required for coordination, and all breakers 250 amp frame size and larger with solid-state trip devices having the following features:

1. Ambient Compensation: Trip device insensitive to temperature changes between minus 20 degrees C and plus 55 degrees C.
2. Adjustability: Breaker ratings and trip settings shall be changeable by operation of controls on front panel of breaker and by change of plug-in element without removing the breaker.

a. The trip device sensor shall have the same rating as the frame amperage of the circuit breaker unless noted otherwise.

3. Ground-Fault Tripping: Provide adjustable pick-up and time-delay on circuit breakers indicated with GFI.

PART 3 - EXECUTION:

3.1 INSTALLATION:

A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions. Install OCPDs level and plumb.

B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPD's in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.

C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.

D. All fuses for new disconnect switches or MCC’s feeding motors or motor starters shall be provided with Class J fuses.

E. OCPDs and mounting accessories installed in existing equipment shall match the existing manufacturer and be rated for the available fault current.

3.2 IDENTIFICATION:

A. Identify components in accordance with Division 26 Section on electrical identification.

3.3 CONTROL WIRING INSTALLATION:

A. Install wiring between OCPDs and control/indication devices.

3.4 CONNECTIONS:

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING:

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL:

A. Reports: Prepare written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made. Tests shall be made on all new and existing OCPD's provided and/or connected under this project in accordance with this section.

B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

C. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

D. Upon completing installation of the system, perform the following tests on all new equipment and existing equipment as indicated on the drawings:

1. Visual and mechanical inspection: Include the following inspections and related work.

    a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters.
    b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
    c. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
    d. Check tightness of electrical connections of OCPD’s with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
    e. Clean OCPD’s using manufacturer's approved methods and materials.
    f. Verify installation of proper fuse types and ratings in fusible OCPD’s.

2. Electrical Tests: Perform the following tests in accordance with manufacturer's instructions:

    a. Insulation resistance test of fused power circuit devices, insulated-case, and molded-case circuit breakers, 600-ampere frame size and over at 1000 degree V D.C. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
    b. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
    c. Make continuity tests of circuits.
    d. Provide full rated primary current tests conforming to IETA testing standards of all new breakers 100 amperes and greater, connected under this project. Inspect breakers and provide test report. Set breakers to previous or new settings as directed prior to test.
    e. Verify relay operation by introduction of accurately metered currents into overcurrent/ground fault/ and other circuitry at values which will enable accurate determination of the tripping or activation values.

E. Make adjustments for final settings of adjustable-trip devices.

F. Activate auxiliary protective devices such as ground fault relays, to verify operation of shunt-trip devices.

G. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.

3.7 CLEANING:

A. Upon completion of installation, inspect OCPD’s. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION:

A. Training: Demonstrate OCPD’s and train Owner's maintenance personnel.

B. Conduct a minimum of one half day of training in operation and maintenance as specified under in the Project Closeout Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.

C. Schedule training with at least seven days' advance notification.

END OF SECTION 262800

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY:

A. Extent, location, and details of lighting work are indicated on drawings and in schedules.

B. Types of lighting in this section include the following:

1. Light Emitting Diode (LED)

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Shop Drawings: Submit layout drawings of lighting and their spatial relationship to each other. In addition, submit luminaire cut sheets from the manufacturer. For standard products submit shop drawings; for non-standard products submit in booklet form with separate sheet for each luminaire, assembled by "luminaire type" with proposed luminaire and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system. Shop drawings shall detail luminaire dimensions, weights, methods of field assembly, mounting components, features and accessories. All features and accessories shall be clearly defined.

C. Wiring Diagrams: Submit wiring diagrams for lighting showing connections to electrical power panels, switches, dimmers, controllers, and feeders. Differentiate between portions of wiring which are manufacturer-installed and portions which are field- installed.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with lighting work similar to that required for this project.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver lighting in factory-fabricated containers or wrappings, which properly protect luminaires from damage.

B. Store lighting in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.

C. Handle lighting carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.5 SEQUENCING AND SCHEDULING:

A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting with other work.

B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

1.6 EXTRA MATERIALS:

A. Drivers: Furnish stock or replacement drivers amounting to 5%, but not less than 2 of each type used in each type luminaire.

B. Lenses: Furnish stock or replacement lenses amounting to 3%, but not less than one, of each type and size used in each type luminaire.

C. LED Modules: Furnish replacement modules amounting to 3% of each type.

D. Deliver replacement stock as directed to Owner's storage space.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Luminaire Manufacturers: Subject to compliance with requirements, provide luminaires as listed in the luminaire schedule or elsewhere on the drawings or specification.

B. LED Manufactures:

1. Per Luminaire Schedule

C. All other manufacturers shall request prior approval and supply test data from an independent testing laboratory and comparison report to substantiate compliance with specifications and specified equipment.

2.2 EQUIPMENT:

A. General: Provide lighting of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lamp holders, reflectors, energy efficient ballasts, starters and wiring. Ship luminaires factory-assembled, with those components required for a complete installation. Design luminaire with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise and as to disconnect ballast when door is opened for HQI lamps.

B. Lamps:

1. Provide LED’s that retain 70% of lamp life after 50,000 hours. LED’s shall be binned to NEMA standard SSL 3-2010. All LED products and information to be in accordance with IES Standards LM79 & LM80.

2. Provide all lamps with CRI 85 or higher unless otherwise indicated. It is important that color fidelity (color rendering aspects of lamp sources) and color appearance (the consistent appearance of the light source) are provided for all lamps.

C. LED Drivers: THD less than 10%. All 0-10V drivers shall be provided with isolation on the secondary analog side to eliminate secondary voltage on the 0-10V channel.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which lighting is to be installed, and substrate for supporting lighting. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

A. Install lighting at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.

B. Provide luminaires and/or outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Architect.

1. Luminaires shall be positively attached to the suspended ceiling system. The attachment device shall have a capacity of 100% of the luminaire weight acting in any direction.
2. When intermediate systems are used, No. 12 gauge hangers shall be attached to the grid members within 3" of each corner of each luminaire.
3. When heavy-duty systems are used, supplemental hangers are not required if a 48" modular hanger pattern is followed. When cross runners are used without supplemental hangers to support luminaires, these cross runners shall provide the same carrying capacity as the main runner.
4. Luminaires weighing less than 56 pounds shall have, in addition to the requirements above, two No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.
5. Luminaires weighing 56 pounds or more shall be supported directly from the structure above by four No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.

C. Install flush mounted luminaires properly to eliminate light leakage between frame and finished surface.

D. Provide plaster frames for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

E. For air supply type troffers, retain side slot closures in place for adjustment by Balancing Contractor.

F. Fasten luminaires securely to structural supports; and ensure that pendant luminaires are plumb and level. Provide individually mounted pendant luminaires longer than 2 feet with twin stem

hangers. Provide stem hanger with ball aligners and provisions for minimum one inch vertical adjustment. Mount continuous rows of luminaires with an additional stem hanger greater than number of luminaires in the row.

1. Pendant hung luminaires shall be supported directly from the structure above with No. 9 gauge wire or approved alternate support without using the ceiling suspension system for direct support.
2. Luminaires mounted in areas of high seismic activity shall be mounted from a rigid stem to restrain sway. If mounted from a non-rigid stem, luminaires to be mounted such that their sway under seismic conditions does not impact another luminaire within 45˚ swing from nadir.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.

H. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box stud.

I. Set units plumb, square, level and secure according to manufacturer’s written instructions and shop drawings. Refer to specification section 265613, “Poles and Standards” for other requirements.

3.3 FIELD QUALITY CONTROL:

A. At Date of Substantial Completion, replace lamps in lighting which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Architect.

3.4 ADJUSTING AND CLEANING:

A. Clean lighting of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses and reflectors.

B. Protect installed luminaires from damage during remainder of construction period.

C. Adjust aimable luminaires to provide required light intensities and in compliance with design intent.

3.5 GROUNDING:

A. Provide equipment grounding connections for lighting as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

B. Ground luminaires according to Section 260526, "Grounding," and Section 265613, "Poles and Standards."

3.6 WARRANTY

A. The Contractor shall guarantee all equipment including ballasts, lamps, luminaires, wiring, etc. free from inherent mechanical and electrical defects. Warranty period shall be from date of acceptance as set forth in the general conditions with periods as follows:

1. Lamps - Per Paragraph 3.3
2. Luminaires, wiring, etc. - 1 year
3. Ballasts - The manufacturer shall provide a full five year warranty beginning at time of substantial completion. The manufacturer shall replace any and all failed ballasts within 48 hours of notification. The manufacturer shall provide the labor for warranty replacements.
4. LED and Driver – Five year manufacturer’s warranty.

3.7 DEMONSTRATION:

A. Upon completion of installation of lighting and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 265000

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SECTION 270100 - OPERATION AND MAINTENANCE OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. This section is inclusive to all Division 27 sections.

1.2 DRAWINGS

A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.

B. All work shall be subject to the Owner’s direction and approval.

1.3 SUMMARY

A. This project consists of providing a system of communications pathways, spaces, and associated equipment for the Colorado Mountain College (CMC) Spring Valley Nursing Renovation in Glenwood Springs CO. The structured cabling system includes pathways, equipment, and data cabling locations as shown on the drawings for the project. The area of renovation is already connected to the campus network via copper and fiber cables, which shall remain in place and functional as existing.

B. Coordinate all requirements with CMC Facilities and Information Technology (IT) Departments prior to beginning any work.

C. All Division 27 Communications work and supplied equipment shall be in compliance with CMC Network Services Infrastructure Standards, Updated 2-19-18.

D. The project scope of work includes:

1. Provide pathways, spaces, and associated equipment for the communications structured cabling system, as described within the division 27 documents and as shown on the “T” series drawing sheets.
2. Provide the necessary parts and supplies whether specifically mentioned or not, to turn over to the owner a complete system of communications pathways.

3. Note, structured cabling solution (cabling, connectors, racks) provided by Owner's preferred vendor, outside of project.

1.4 QUALITY ASSURANCE

A. In addition to procedures stated in Division 1:

1. Cutting and Patching
   a. Perform required cutting, drilling and chasing to receive new equipment. In general, perform all patching and repairing necessary to restore to original condition, all surfaces that may become damaged during the installation. All work shall be executed by persons normally employed in the type of work to which they are assigned.
   b. Paint all structural steel and all steel parts used for hangers and for supporting conduits, junction boxes and technology equipment with one (1) coat of "red" oxide primer before erection. After steel is in place, paint again with a minimum of one (1) coat of paint, color as directed by the Architect.
   c. The contractor is responsible for all cutting, patching, plastering and painting associated with the new installation.
2. Clean Up
   a. The job-site shall be cleaned at the end of each day.
   b. Upon completion of the contract, remove all workmen's appurtenances from the premises. Clean the premises of all debris caused by the work and leave the installation clean and in first-class operating condition.
3. Storage of Material and Equipment
   a. Store materials and equipment in a location approved by the Owner.
   b. Be responsible for securing all equipment and materials employed in the installation until final acceptance by the Owner. The Owner will not be responsible for loss reimbursement to the Contractor.
   c. Be responsible for the replacement of all damaged or defective work, materials or equipment. Do not install sensitive or delicate equipment until major construction work is completed. Ensure that equipment is protected from all construction site activities.
   d. Observe and conform to all applicable safety regulations required by the Owner and O.S.H.A.

1.5 INTERPRETATION AND CONFLICTS

A. Bring any discrepancies determined or omissions found lacking in the Contract Documents to the Technology Consultant's attention before submitting the bid. After award of Contract, the Owner or Technology Consultant will make the interpretation of any conflict.

B. The failure to question any controversial item will constitute acceptance by the Bidder who shall execute it to the satisfaction of the Owner after being awarded the Contract.

C. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the Contract. After the Contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, will not be recognized.

D. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Architect and the Technology Consultant for clarification and direction.

E. All work shown shall be new work provided under this Contract except that work labeled “present to remain” and that equipment labeled “to be furnished by others, but installed by the Contractor”.

1.6 LABELING AND IDENTIFICATION

A. Clearly Label all new equipment, devices and miscellaneous apparatus for easy identification and for safety.

B. Owner will identify and provide labeling schemes for all patch panels, wall plate end point locations, 66/110 blocks, fiber termination cabinets, and backbone cables according to Owners standards.

1.7 LOCATION OF EQUIPMENT AND RACEWAY

A. The drawings are diagrammatic and indicate the general arrangement of equipment to be installed.

B. Coordinate the structural, electrical/electronic and finished conditions of work accordingly.

C. Coordinated locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site. Install all items to accommodate the various conditions in the building and make deviations necessary without additional cost.

1.8 WIRING METHODS

A. Install all wire and cable located in finished areas in new or existing raceways as indicated on Drawings.

B. Install new raceways in the locations shown on the drawings and as specified.

1.9 ORDINANCES AND CODES

A. Nothing contained in the Specifications or shown on the drawings shall be construed as to conflict with any local, municipal or state laws and regulations, governing the installation or other contract work, and all such ordinances and regulations, including the latest: National Electric Code, ANSI/EIA/TIA standards and the National Electric Safety Code, are hereby incorporated and made a part of these Specifications, and shall be satisfied by the contractor at no additional expense to the Owner.

B. Secure all permits and inspection certificates for submission to the owner.

1.10 SYSTEM CONTINUITY

A. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.

1.11 SUBMITTALS

A. Shop drawings shall be checked, corrected and approved by the contractor before being submitted to the Owner/Technology Consultant for approval. Before submitting shop drawings, the Contractor shall carefully examine them and shall certify by his stamp/signature that, to the best of his knowledge, they comply with the Contract Documents. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to fabricating or installing any materials. Approval will be given based upon shop drawings. The shop drawings shall indicate complete details of work to be performed. Drawings shall include a title block naming the Project, Architect, Technology Consultant, Contractor, drawing title, drawing number, revision number if applicable and date. Submit all Shop Drawings complete as a single submission. Isolated items will not be accepted, except with prior approval.

B. Where the shop drawings deviate from the requirements of the Contract documents, the Contractor shall (1) correct the shop drawings as required, or (2) where the deviations do not necessarily require correction, notify the Owner/Technology Consultant of the deviations.

C. Submit to the Architect four (4) sets of shop drawings or otherwise documents/equipment for the following equipment and obtain written approval before ordering materials. See the drawings and scope information for applicability of product to phase and project.

D. The contractor shall provide product submittals for all system components as defined in Part 2 of all associated communication specification sections related to this project. These components shall include:

1. Grounding and Bonding Equipment
2. Basket Style Cable Tray
3. Hangers and Supports
4. Strain Relief Products
5. Equipment as identified on Sheet T-001 Contractor Responsibility Matrix
6. All other equipment identified or inferred as may be required by the Architect, Technology Consultant or Owner.

E. Submit complete submittal list for Architect/Technology Consultant approval prior to purchasing any equipment.

F. The selected contractor will allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.

G. In some cases, manufacturer warranty may call for the review of system documentation to assure that the system design meets manufacturer warranty requirements. In such instance, with prior approval of the Owner, the contractor shall provide a complete set of Project Documents and product data to the system manufacturer for review. The system manufacturer shall review the complete system package and provide documentation attesting to the system compliance with manufacturer warranty requirements. This documentation shall be included with the Contractor Shop Drawings submittal. The Technology Consultant will not review the Contractor Shop Drawings submittal, which does not include the manufacturer warranty compliance review documentation.

H. Isolated items will not be accepted, except with prior approval

I. Each shop drawing shall contain reference to the applicable drawing and specification section and verification of compatibility with the systems involved.

J. All nameplate data shall be submitted with equipment submittals – refer to other sections for complete identification requirements.

K. Shop drawings shall show conformance with specified performance characteristics, or the Contractor shall assume responsibility for all deviations including all additional costs as a result of the deviations.

1.12 STANDARDS OF MATERIAL AND WORKMANSHIP

A. All work shall be executed by persons skilled in the work to which they are assigned. This shall include all copper and fiber connections including testing, and all plastering and painting.

B. All materials and equipment in the work shall be new and of first quality, produced by manufacturers of recognized reputation for each line of material and equipment. The fact that materials or equipment offered have been recently developed or are untried may be sufficient justification for their rejection.

1.13 PROTECTION OF WORK AND EQUIPMENT

A.

A. This Contractor shall use the required safety precautions, methods and skills to prevent possible unsafe conditions or conditions unduly susceptible to fire.

B. When this Contractor is working in areas in which the building occupants have access, contractor shall provide suitable barriers around his operation.

C. This contractor is responsible for containing the undue spread of vapors or odors from his work area.

1.14 TESTS AND INSTRUCTIONS

A. Upon completion of the work, and upon the request of the Architect, the Contractor shall be prepared to test all systems in the presence of the Owner, Architect, or Technology Consultant. Such testing shall occur at a time that is mutually acceptable to all parties. The Contractor's representatives assisting in the performance of these tests shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing the system.

B. The contractor will provide the owner with all manufacturers' systems certifications within 60 days of completion of work. Contractor's final retention payment will not be released until all manufacturers' system certifications have been received, reviewed and approved by the Architects Technology Consultant.

C. Correct all failures or improper conditions.

D. Demonstrate to the Owner the proper care and maintenance of all new items.

1.15 GUARANTEE

A. Unless stated otherwise in Division 1:

1. The contractor and his surety shall guarantee in writing for a minimum period of one (1) year from the date of final acceptance that all materials, equipment and labor furnished by contractor are free from defects.
   a. Refer to cable system warranty for additional requirements.
2. The Contractor shall further guarantee that if any piece of material or equipment is found to be defective within the guarantee period because of faulty manufacture or faulty installation, in the opinion of the Owner, contractor will replace and install and test such material or equipment without any further expense to the Owner.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

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SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

B. This section is inclusive to all Division 27 sections.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for the structured cabling system, pathways and associated equipment. It includes contractor qualifications, terminations and testing parameters. Reference individual sections for further expansion of these requirements.

B. Permits, Inspections, Codes and Regulatory References

1. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract, and shall submit approval certificates to the Technology Consultant.
2. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances and regulations applicable to electronic and electrical installations.
3. The following industry standards are the basis for the structured cabling system described in this document:
   a. TIA-568-D.1 General Requirements
   b. TIA-569-D Commercial Building Standard for Telecommunications Pathways
   c. TIA-606-B Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
   d. TIA-607-C Commercial Building Grounding/Bonding Requirements
   e. NFPA National Fire Protection Association
   f. NFPA 70 National Electric Code (NEC)
   g. ISO/IEC International Organization of Standards/International Electrotechnical Commission

C. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

D. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

1.3 ABBREVIATIONS AND DEFINITIONS

A. General: In addition to abbreviations defined in Division 1, utilize the following abbreviations and definitions for discernment with the Drawings and Specifications.

B. Abbreviations:

1. ANSI American National Standards Institute
2. ASA American Standards Association
3. ASTM American Society of Testing Materials
4. AVC Audiovisual Contractor
5. EC Electrical Contractor
6. EIA Electronic Industry Association
7. ETL Electrical Testing Laboratories, Inc.
8. GC General Contractor
9. ICEA International Cable Engineers Association
10. ICIA International Communications Industries Association
11. IEEE Institute of Electrical and Electronics Engineers
12. NEC National Electric Code
13. NEMA National Electrical Manufacturers Association
14. NFPA National Fire Protection Association
15. NIC Not In Contract
16. NRTL Nationally Recognized Testing Laboratory
17. O Owner
18. OEM Original Equipment Manufacturers
19. OSHA Occupational Safety and Health Administration
20. OSP Outside Plant
21. SCC Structured Cable Contractor
22. TC Technology Consultant
23. TIA Telecommunications Industry Association
24. UL Underwriter's Laboratories, Inc.

C. Definitions:

1. ACCEPTED means as accepted by the Technology Consultant or his representative.
2. APPROVED means as approved by the Technology Consultant or his representative.
3. ARCHITECT means Hord Coplan Macht or their designated representative.
4. AS DIRECTED means as directed by the Technology Consultant or his representative.
5. AS REQUIRED means as required by some other part of the contract documents which may include reference specifications or manufacturer’s recommended practice.
6. AS SHOWN means as shown on the drawings, shop drawings or other graphical elements of the contract documents.

7. BIDDER is used to indicate that entity generating the bid response.
8. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.
9. CONDUIT means the inclusion of all fittings, hangers, supports, sleeves, etc.
10. CONTRACTOR is used to indicate the successful Bidder to whom the Owner has awarded the contract.
11. EQUAL means equivalent as approved by the Technology Consultant or his representative.
12. FURNISH means to indicate the responsibility to ship or deliver the item to the job site, freight prepaid, for receipt, staging and installation by others.
13. INSTALL means to join, unite, fasten, link, attach, setup or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular work referred to. It is also used to indicate the responsibility of receiving the item at the job site, providing adequate storage, unpacking or uncrating the item, physically securing the item or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.
14. OWNER or CLIENT means Colorado Mountain College (CMC) or their designated representative.
15. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) shall refer to equipment that will be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
16. PROVIDE means to furnish, install, place, erect, connect, test and turn over to Owner complete and ready for the regular operation, the particular work referred to.
17. PROVIDED BY OTHERS shall refer to material and work, which is related to this contract, but has been provided by parties other than the Contractor.
18. SPECIFICATION is defined as the body of documentation provided to the Contractor with the Request for Quotation, as well as all addenda to said documentation. Throughout this document, words such as “herein” refer to the entire Specification, and not just this written document. The Specification includes, but is not limited to, this written specification document, all drawings, as listed in the List of Drawings, cable terminations and labeling schedule, additions and/or modifications as detailed in written addenda, additions and/or modifications as detailed in drawing additions or reissues.
19. TECHNOLOGY CONSULTANT refers to The Sextant Group, Inc., 1550 Larimer Street Suite 462 Denver, CO 80202.
20. The term SHALL is mandatory; the term WILL is informative; and the term SHOULD is advisory.
21. WIRING means the inclusion of all raceways, fittings, conductors, connectors, patch panels, labeling, junction and outlet boxes, connections, testing and all other items necessary and/or required in connection with such work.

D. For the purpose of Division 27, in the event of conflict with an abbreviation or definition in Division 1 and in Division 27, the Division 27 abbreviation or definition shall prevail.

1.4 PERMITS, CODES, STANDARDS, AND INSPECTIONS

A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules and regulations having jurisdiction for work included under this Contract, and shall submit approval certificates to the Technology Consultant.

B. The installation shall comply fully with all local, county and state laws, ordinances and regulations applicable to electronic and electrical installations.

C. Unless stated in Division 1, the installation shall be in compliance with the requirements of the latest revisions of:

1. All approved published instructions set forth by equipment manufacturers.
2. All local codes and ordinances in effect and having jurisdiction.
3. Americans with Disabilities Act (ADA)
4. All requirements of electric and telephone utility companies
5. BICSI Telecommunications Distribution Methods Manual (latest edition)
6. Building Officials and Code Administrators (BOCA)
7. Electronic Industry Association (EIA)
8. Institute of Electrical and Electronic Engineers (IEEE)
9. Legislative Act 235 (1965)-Handicapped
10. Legislative Act 287 (1974)-Excavation
11. National Board of Fire Underwriter’s (NBFU)
12. National Electric Code (NEC)
13. National Electrical Manufacturer’s Association (NEMA)
14. National Electric Safety Code (NESC)
15. Occupational Safety and Health Act (OSHA)
16. Telecommunications Industry Association (TIA)

D. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.

E. Should any change in drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the Technology Consultant prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the Architect and the Technology Consultant at no additional cost to the Owner.

1.5 CONTRACTOR QUALIFICATIONS

A. All bidders shall demonstrate their qualifications by providing the following documents:

1. A list of the LAST five (5) Structured Cabling systems that were installed by the bidder:
2. The listing shall include only systems that included the installation of fiber optic cable and Category 5e or 6 twisted pair.
3. The listings shall be for the last five (5) projects that are completed and have been turned over to the owner.
4. The listing shall include a brief description of the project, size of the system, products used, Owner's name, phone number, address, and representative, date started, and date of completion

B. The bidder shall furnish a list of all test equipment that will be used in the installation and testing of the fiber optics, multi pair copper distribution and UTP cable.

C. The bidder shall have a Registered Communication Distribution Designer (RCDD) with five (5) years' experience, on staff. Submit the RCDD Certificate and project information with bid.

D. All of the above documents shall be submitted along with the Bid Form, by the Bid due date.

E. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data and voice network systems.

F. Personnel must be knowledgeable in local, state, and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall apply.

G. The Contractor shall have been in the business of installing structured cabling systems for a minimum of five (5) years.

H. The Contractor must possess and maintain current liability insurance certificates.

1.6 WARRANTIES

A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

B. Note, structured cabling solution (cabling, connectors, racks) provided by Owner's preferred vendor, outside of project. Warranty and Certification of the Cabling systems and connectors:

1. The Contractor shall provide a minimum 25-year performance and product warranty that installation, cable, connectors and connecting hardware shall be free from defects in

material, workmanship and fabrication. Submit detailed warranty documentation with close out documentation.

2. The system shall be certified by the cable/connector manufacturer and warranted for the specified performance for minimum of 25-year. The Contractor shall conform to the manufacturer's certification including submittals of all required documentation to the manufacturer.
3. The Contractor shall obtain, from the manufacturer, a Registration Document and Certificate for the specific installation issued in the Owner's name. Upon receipt of the Registration Document and Certificate, the Contractor shall forward a copy to the Technology Consultant and deliver the original to the Owner.

C. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

1.7 SUBMITTALS

A. The contractor shall provide product submittals for all supplied equipment, and as identified in section 270100.

1.8 PROJECT DRAWINGS AND SPECIFICATIONS

A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report discrepancies to the Technology Consultant in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Technology Consultant.

B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Technology Consultant. The Architects' interpretation is final and binding.

C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.

D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Technology Consultant.

E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second;

special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

1.9 COOPERATION AND COORDINATION WITH OTHER TRADES

A. The Structured Cabling Contractor shall be responsible for all cross connecting and coordination with vendors and other trades to provide a complete operational system.

1.10 PRODUCT LISTING

A. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, conduit, fittings, sheet metal, solder, fasteners, and similar items, except as otherwise indicated.

B. Provide products that are compatible within systems and other connected items.

C. All powered equipment shall be UL listed and follow approval criteria defined by the local authority having jurisdiction.

1.11 RECORD DOCUMENTS

A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant and Owner a complete set of documents that clearly represent all contract work “as-built”. This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.

B. As part of the completed “As-Built” document package the Contractor will deliver a final cable plant matrix (in spreadsheet format) of Category 6A outlets and floor plan with reference numbers. Final “As-Built” drawings will be delivered in AutoCAD format.

1.12 MAINTENANCE MANUALS

A. Prepare maintenance manuals (Record Document) in accordance with the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer’s data of each piece of equipment.

1.13 GENERAL WARRANTIES

A. Provide complete warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

B. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract Documents or which are damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer, or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.

B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.

C. Where proprietary names are used, whether or not followed by the words "or as approved", they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

D. Where the Contractor proposes substitute equipment, contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work, shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling.

3.2 INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment.

B. Coordinate systems, equipment, and materials installation with other building components.

C. Verify all dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for cabling installations.

E. Sequence, coordinate, and integrate installations of cabling materials and equipment for efficient flow of the Work.

F. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.

G. Coordinate the cutting and patching of building components to accommodate installation of cabling equipment and materials.

H. Coordinate the installation of all materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.

I. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

J. Plywood on MDF/IDF walls shall be void-free fire-resistant grade AC grade or better with a minimum thickness of 0.75 inches with two coats of fire-resistant paint on all useable walls. Use flush hardware and supports to mount plywood. Ensure that the strength and placement

of the hardware are sufficient to handle the total anticipated load and mounting of cabling components.

K. Ensure that the fire rating of all walls and floors is maintained. Plywood backboard sheets will have the fire-rated stamp left visible for inspection.

3.3 CONDUIT AND RACEWAY

A. Actual locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site.

B. Provide a pull box or pull point immediately before and after any conduit or raceway section containing three ninety-degree bends, or any single run exceeding fifty feet in length. Pull box openings must face in the direction from which personnel will approach and must have a minimum eight inches in front of and to all sides of the opening. Pull boxes shall not be used in place of a bend. Conduits must always exit the pull box from the opposite side it entered (no change of direction inside the pull box will be accepted).

C. Carefully investigate the structural, electrical/electronic and finished conditions of work accordingly.

3.4 FIRESTOPPING

A. General

1. Provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables and cable tray. Fire stop shall restore floor and wall to the original fire rated integrity and shall be waterproof. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.
2. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The contractor shall be responsible for verifying the fire rating of all walls and floors having cabling penetrations. Coordinate sealant installation with work of other trades and with the general contractor on site.
3. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) or shall be approved by a qualified Professional Engineer (PE), licensed in the state of Colorado.
4. A drawing showing the proposed fire stop system shall be provided to the Owner and Technology Consultant prior to installing the fire stop system(s).

3.5 GROUNDING AND BONDING

A. Ground communications systems and equipment in accordance with the ANSI/TIA-607-C Grounding Standard and NEC requirements except where the Drawings or Specifications exceed NEC requirements. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, paging equipment, CATV equipment etc. entering or residing in technology spaces shall be grounded to the respective ground system using a minimum #6 AWG solid copper bonding conductor and compression connectors. All wires used for technology grounding purposes shall be identified with green insulated wires. All cables and bus bars shall be identified and labeled in accordance with the Technology Identification requirements.

3.6 TESTING

A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Technology Consultant and shall provide all equipment, instruments and materials to make such tests.

B. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted and left in satisfactory operation condition to suit load conditions, by means of instruments furnished by the Contractor.

C. Notify the Owner and Technology Consultant seven (7) days prior to the testing dates. Upon completion of a test, a statement of certification shall be forwarded to the Technology Consultant for his approval.

END OF SECTION

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SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

B. Drawings and general provisions including Division 1, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Commercial building grounding and bonding requirements for telecommunication infrastructure.
2. Requirements for bonding and communications cabling, equipment, pathways, spaces, and mounting equipment.
3. Basic requirements for grounding for protection of life, equipment circuits and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

B. Comply with the ANSI/TIA Standard 607-C, “Grounding and Bonding Requirements” and the NEC.

1.3 RELATED SECTIONS:

A. Section 013300 – Submittal Procedures

B. Section 260526 – Grounding and Bonding for Electrical System

C. Section 270100 – Operation and Maintenance of Communications Systems

1.4 REFERENCES

A. ANSI/NFPA-70, 2011 National Electrical Code (NEC)

B. ANSI/IEEE Std. 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment

C. ANSI/IEEE Std. C2, 2007 National Electrical Safety Code (NESC)

D. TIA-607-C Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises

E. ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure

F. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

G. OSHA Standards and Regulations - all applicable

H. Local Codes and Standards - all applicable

I. Anywhere low-voltage cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either. Knowledge and execution of applicable codes is the sole responsibility of the Contractor. Any code violations committed at the time of installation shall be remedied at the Contractor's expense. Contractor is responsible to bring any perceived conflicts between project documents and referenced Standards or Codes to the attention of the Architect and Technology Consultant for resolution.

1.5 SYSTEM DESCRIPTION

A. Provide a communications bonding and grounding system as described in this document and project drawings and in compliance with the above cited Codes, Standards and Agencies.

B. Comply with the requirement of Code of Practice for Info-Communications Facilities in Buildings.

C. Comply with the requirement for Section 260526 - Grounding and Bonding for Electrical System.

D. Bond the following items within the telecommunications grounding system.

1. All communications system active equipment.

2. All PDU and surge protection equipment.
3. Raised floor systems.
4. Underfloor grounding grids (a.k.a. "supplemental bonding grids" or SBGs) for computer or telecommunications rooms.
5. Metallic raceway systems, including metallic cable trays.
6. Communications equipment enclosures (cabinets) or cross-connect frames.
7. Broadband passive devices.
8. Metallic splice cases.
9. Metallic cable screens, armor or shields.
10. All metal cable conduit.
11. Electrical service panels in entrance facilities, telecommunications and equipment rooms.
12. Wall and rack mounted grounding busbars.
13. Exposed building steel that is within 6 feet of equipment racking systems.
14. Building steel extending to earth in outside-plant.
15. All related bonding accessories.

1.6 SUBMITTALS

A. Submit the following:

1. The contractor shall provide product submittals for all system components as defined in Part 2 of this specification section and all associated project specifications. These components shall include all grounding and bonding products required for a complete grounding and bonding system.
2. Shop drawings showing construction details and locations of components, and description and routing of interconnecting cabling.
3. Field-testing organization certificates, signed by the contractor, certifying that the organization performing the tests complies with the requirements specified in Quality Assurance below.

B. The selected contractor will allow sufficient time in project scheduling for client and review by the Architect and Technology Consultant.

1.7 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings of types and rating required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3-years.

B. Installer: Qualified with at least 3-years of successful installation experience on projects with technology ground work similar to that required for this project.

C. Listing and labeling: Provide products specified in this Section that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the National Electric Code, Article 100.

D. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

E. Field-testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM699, that it has the experience and capability to satisfactorily conduct the testing indicated.

F. Component Standard: Components and installation shall comply with NFPA 70, “National Electric Code” (NEC).

G. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical and electronic grounding.

H. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical and electronic grounding.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. B-Line Systems, Inc.
2. Burndy Corp.
3. Crouse-Hinds Co.
4. Electrical Components Division; Gould Inc.
5. General Electric Supply Co.
6. Ideal Industries, Inc.
7. Panduit.
8. Thomas & Betts Corp.

2.2 PRODUCTS

A. Supply types indicated and of sizes and rating to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 CONDUCTOR MATERIALS

A. Copper with minimum 98% conductivity.

2.4 WIRE AND CABLE CONDUCTORS

A. Coordinate with Division 26 Sections.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors:

1. Conform to the following:
   a. Solid Conductors: ASTM B-3.
   b. Assembly of Stranded Conductors: ASTM B-8.
   c. Tinned Conductors: ASTM B-33.

2.5 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section. All bus bars shall be two-hole lug type.

B. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

C. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire, 3/4” wide, 9-1/2” long; 48.250cm. Protect braid with copper bolt-hole ends with holes sized for 3/8” diameter bolts.

2.6 CONNECTOR PRODUCTS

A. Listed and labeled as grounding connectors for materials used and approved by a nationally recognized testing laboratory.

B. Pressure Connectors:

C. High-conductivity-plated units.

1. All lugs shall be two-hole type.

D. Bolted Clamps: Heavy-duty units listed for the application.

2.7 GROUNDING ELECTRODES

A. For technology systems, provide a #2 AWG minimum insulated stranded copper conductor from the grounding electrode system to each telecommunication room, terminal cabinet and central location.

B. Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by manufacturers for indicated applications.

C. Connectors, Terminals and Clamps will be compression type.

D. Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials and bonding straps, as recommended accessories by manufacturers.

2.8 pipe clamps

A. Used to ground copper code conductor to water pipe or copper tubing.

B. Cast from high strength, electrolytic bronze to provide reliable grounding connections.

C. Plated steel screws provide high strength and inhibit corrosion.

D. Accommodates a wide range of pipe, tube, rod and conductor sizes - minimizes inventory.

E. cULus 467 Listed for grounding and bonding with AWG conductor.

F. Approved bronze grounding pipe clamps are as follows:

Part Number	Description
GPC2-1-Q	For pipe range 1/2 – 1" and conductor size range #10 SOL - #2 STR
GPC2-2-L	For pipe range 1 1/4 – 2 and conductor size range #10 SOL - #2 STR
GPC2-4-X	For pipe range 2 1/2 – 4 and conductor size range #10 SOL - #2 STR
GPC2-6-X	For pipe range 4 1/2 – 6 and conductor size range #10 SOL - #2 STR

2.9 bronze grounding clamps for conduit

A. Used to ground copper conductor parallel to, or at a right angle to a rod, tube, or pipe.

B. Made from high strength, electrolytic cast bronze.

C. High strength silicon bronze hardware provides long term reliable assembly.

D. Accommodates a wide range of pipe, tube, rod and conductor sizes - minimizes inventory.

E. cULus 467 Listed for grounding and bonding with AWG conductor and suitable for direct burial in earth or concrete.

F. Approved bronze grounding conduit clamps are as follows:

Part Number	Description
GPL-8-Q	For pipe size inches 1/2 or 3/4 and conductor size range AWG #8 SOL - #4 STRL
GPL-14-X	For pipe size inches 1 and conductor size range AWG #8 SOL - #4 STR
GPL-22-X	For pipe size inches 1 1/4 and conductor size range AWG 2/0 SOL – 250 kcmil
GPL-28-X	For pipe size inches 1 1/2 and conductor size range AWG 2/0 SOL – 250 kcmil
GPL-34-3	For pipe size inches 2 and conductor size range AWG 2/0 SOL – 250 kcmil

2.10 bronze grounding clamps for lay-in feature

A. Bonds water pipe to continuous copper grounding conductors.

B. High strength, electrolytic cast bronze.

C. Phos bronze hardware provides long term reliable assembly.

D. cULus 467 Listed for grounding and bonding and suitable for direct burial in earth or concrete.

Part Number	Description
GPLAC2-1-C	For conductor run parallel to pipe. Pipe size inches 3/4” or 1” and conductor size range AWG #10 SOL - #2 STR
GPLBC2-1-C	For conductor run perpendicular to pipe. Pipe size inches 3/4” or 1” and

	conductor size range AWG #10 SOL - #2 STR

2.11 Zinc ground clamp

A. Bonds steel and aluminum pipe to aluminum conductors

B. Made from die cast zinc

C. Zinc plated steel hardware

D. cULus 467 Listed for grounding and bonding

Part Number	Description
GPCZ2-1-C	Pipe size inches 3/4” or 1” and conductor size range AWG #10 SOL - #2 STR

2.12 Compression-type Aluminum-to-Copper Reducing Splice

A. Dual rated for use with aluminum or copper conductors.

B. Factory pre-filled with joint compound and sealed with easy pull-out end plug to inhibit corrosion.

C. Color-coded end plug and Panduit die index numbers marked on barrel for proper crimp die selection

D. Tin-plated to inhibit corrosion

E. For use up to 35 KV and temperature rated 90°C when crimped with Panduit crimping tools and dies

Part Number	Description
SAR2-4-X	Bonds aluminum conductor size #2 AWG to Aluminum or copper conductor size #4 AWG

2.13 Copper and Aluminum One-Hole Grounding Lay-in Lug for bonding ladder rack

A. Used for quick installation of a continuous grounding conductor

B. cULus 467 Listed for grounding and bonding, copper lugs. UL Listed for direct burial in earth or concrete

C. cULus Listed for use up to 600 V and temperature rated 90°C

Part Number	Description
LICC4-22-C	Copper body, 0.22 inch stud hole, conductor size range AWG #14 SOL - #4 STR
LICC4-22TP-C	Tin plated copper body, 0.22 inch stud hole, conductor size range AWG #14 SOL - #4 STR
LIAC4-22-C	Tin plated aluminum body, 0.22 inch stud hole, conductor size range AWG #14 SOL - #4 STR
LIAS1/0-14-L	Tin plated aluminum body, 0.27 inch stud hole, conductor size range AWG #14 SOL - #1/0 STR
LIAS250-56-Q	Tin plated aluminum body, 0.33 inch stud hole, conductor size range AWG #6 SOL – 250 kcmil STR

2.14 communications grounding rods

A. Material: Copper-clad steel.

B. Size: 3/4-inch by 8 feet long.

C. Standards: Meet requirements of ANSI®/UL 467-1984, CSA, and ANSI/NEMA GR-1.

D. Approved manufacturers:

1. Erico

2.15 electrolytic ground rods

A. Where standard ground rods do not have acceptable levels of conductivity (typically greater than 5 ohms resistance) to earth due to local soil conditions, electrolytic systems may be considered.

B. Such systems shall meet the following:

1. Be comprised of a hollow stainless steel or copper tube 10 feet or longer and filled with a mixture of hygroscopic electrolytic salts.
2. Function as an active grounding system by absorbing moisture out of the air and constantly leaching and electrolytic solution into the surrounding soil to maintain high conductivity.
3. Rod shall be encased in a conductive, non-corrosive carbon based back fill material.

4. Provide low resistance to ground.
5. Provide season to season stability.
6. Be maintenance-free for 30 years.
7. Contain no hazardous materials or chemicals.

2.16 Telecommunications Bonding Backbone (TBB) Grounding Conductors

A. To be bare or insulated copper, of minimum conductor size #6 AWG and sized at 2 kcmil per linear foot up to a maximum size of 750 kcmil.

B. Where un-insulated, to be identified with green tape at termination location.

C. Labeled in accordance with recommendations set forth in ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure.

D. Approved manufacturers:

1. General Cable
2. Southwire

2.17 Two-hole, Long-barrel Copper Compression Lugs for Grounding Conductors

A. Meets TIA-607-C requirements for network systems grounding applications.

B. Tested by Telcordia - meets NEBS Level 3 with AWG conductor.

C. UL Listed and CSA Certified with AWG conductor for use up to 35 KV** and temperature rated 90°C when crimped with Panduit crimping tools and dies.

D. Color-coded barrels marked with Panduit die index numbers for proper crimp die selection.

E. Have long barrel to maximize number of crimps and provides premium wire pull-out strength and electrical performance.

F. Have "inspection window" over tongue to visually assure full conductor insertion.

G. Be tin-plated to inhibit corrosion.

H. Available with NEMA and BICSI hole-sizes and spacing.

I. Approved Manufacturers for lugs:

1. Panduit

Part Number	Description
LCC-W series	Panduit two-hole compressing lugs for code conductors in BICSI hole spacing

2.18 Code/Flex Conductor H-TAPs

A. Used as a splice, or to tap smaller (pigtail) conductors into larger continuous conductors.

B. Each HTAP terminates a wide range of conductor sizes and combinations of code and flex conductors Class G, H, I and Locomotive to suit a variety of applications.

C. Slotted design allows quick and easy assembly of conductor to HTAP using three Panduit 94V-0 cable ties.

D. Tap grooves are separated from one another, allowing them to function independently so HTAP can be used with single or multiple conductors, providing maximum design and installation flexibility.

E. Color coded and marked with Panduit die index numbers for proper crimp die selection.

F. UL Listed and CSA Certified, with wide size range of conductor sizes and rated for applications up to 600 V when crimped with Panduit tools and dies.

G. Tin plated to inhibit corrosion.

H. Available with an assortment of clear covers with integrated label fields.

I. Approved Manufacturers for HTAPs and clear covers:

1. Panduit

J. Approved parts for HTAPs are as follows

Part Number	Description
HTCT series	Panduit HTAPs. Must be selected according AWG size of run and tap conductors.
CLRCVR series	Panduit clear covers for HTAPs. Must be selected according to HTAP

	being covered.

2.19 Code Conductor, Thin Wall, Tin-plated C-TAP (splice)

A. For copper-to-copper splicing or pigtail tap splicing.

B. Wide wire range-taking capability minimizes inventory requirements.

C. Color-coded for proper crimp die selection.

D. Ribbed design provides high strength.

E. Made from high conductivity wrought copper.

F. Tin-plated to inhibit corrosion and oxidation.

G. UL Listed and CSA Certified with AWG conductor to 600 V and temperature rated to 90°C when crimped with Panduit crimping tools and dies.

H. Approved Manufacturers for C-TAPs:

1. Panduit

I. Approved parts for C-TAPs are as follows:

Part Number	Description
CTAPF series	Panduit C-TAPs. Must be selected according AWG size of conductors being spliced.

2.20 IEEE Universal Beam Grounding Clamp

A. For bonding structural steel (ex: I-beams) into bonding network.

B. Universal, fits on a wide range of standard (angled) and wide flange (parallel) structural steel beams.

C. Provide a mounting pad suitable for a two-hole compression lug.

D. Installs quickly and easily with standard 1/4" key hex wrench tooling.

E. UL 467 Listed and CSA 22.2 Certified for grounding and bonding suitable for direct burial in earth or concrete.

F. Comply with vibration tests per MIL-STD-202G (METHOD 201A).

G. Approved Manufacturers for beam grounding clamps:

1. Panduit

H. Approved parts for beam grounding clamps are as follows:

Part Number	Description
GUBC500-6	Panduit Universal Beam Grounding Clamp for copper conductor sizes ranging from #6 AWG to 500 kcmil and flange thickness from .25" to .675". Stud size is 1/2" with hole spacing for two hole lug being 1.75" and thread size from 1/2 to 13.

2.21 Split Bolt for Bonding Cable Trays

A. Made from high strength copper alloy to resist corrosion and provide premium electrical and mechanical performance.

B. Wire range-taking capability minimizes inventory requirements.

C. Nut hex provides correct fit with socket, box, or open end wrenches resulting in proper torqueing of electrical connection.

D. Pressure bar provides secure connection on a full range of conductor combinations used with each connector assuring premium wire pull-out strength.

E. UL Listed and CSA Certified with AWG conductor for use up to 600 V and temperature rated 90°C.

F. Available in tin-plated version for bonding to galvanized wire baskets and Flex Tray.

G. Approved Manufacturers:

1. Panduit

H. Approved parts for split lugs to bond wire basket tray

Part Number	Description
SBC3-C	Panduit split lug for #8 AWG to #4 AWG code conductors
SBCT3-C	Panduit split lug for #8 AWG to #4 AWG code conductors - tinned for use with galvanized basket tray delivery systems

2.22 Auxiliary Cable Brackets (Conductor Pathway)

A. Used for mounting telecommunications bonding conductors outside of cable tray.

B. Maintain minimum 2" separation between bonding conductors and all other types of cabling per TIA 607-C.

C. Bonds ladder rack, wire basket sections together without drilling holes or applying other split-bolt clamps.

D. Supports grounding conductors in the telecommunications room, allows separation of grounding conductors from other cables.

E. Holds up to four conductors in sizes up to 750 kcmil.

F. Bonds to all 1" and 2" ladder rack rails.

G. Paint piercing teeth provide electrical continuity between cable pathway sections while minimizing debris.

H. Front and back mounting screw options allow easy installation and visual inspection.

I. Can be mounted above or below the cable pathway system for flexibility.

J. Meet requirements TIA-607-C.

K. Have available bonding jumper kits to bond sections of basket tray or ladder rack.

L. Approved Manufacturers:

1. Panduit

M. Approved brackets for running bonding backbones parallel to ladder rack or Flex Tray:

Part Number	Description
GACB-2	Auxiliary cable bracket; 1.63" (41.4mm) width, 3.95" (100.3mm) height, 5.22" (132.6mm) depth; provided with one mounting screw.
GACBJ612U	Auxiliary cable bracket jumper for bonding pathway sections; #6 AWG (16mm²); 12.0" (305mm) length; factory terminated on both ends with straight, two-hole, long barrel compression lugs; provided with .16 oz. (5cc) of antioxidant and four mounting screws.

2.23 Wall-mount Busbars (TGB and TMGB and labeling)

A. Meet BICSI and TIA-607-C requirements for network systems grounding applications.

B. Employ BICSI hole spacing to fit LCC-W series 2-hole lugs.

C. Be made of high conductivity copper and tin-plated to inhibit corrosion.

D. Come pre-assembled with brackets and insulators attached for quick installation.

E. Use Panduit component labels, sold separately, to identify busbars to meet TIA-606-B.

F. Approved Manufacturers:

1. Panduit

G. Approved wall-mount grounding busbars are as follows:

Part Number	Description
GB2B0306TPI-1	Telecommunications grounding busbar (TGB) with 6 number of mounting positions with 1/4" stud hole and with 5/8" hole spacing, and 3 number of positions with 3/8" stud hole with 1" hole spacing
GB2B0312TPI-1	Telecommunications grounding busbar (TGB) with12 number of mounting positions with 1/4" stud hole with 5/8" hole spacing, and 3 number of positions with 3/8" stud hole with 1" hole spacing
GB4B0624TPI-1	Telecommunications main grounding busbar (TMGB) with 24 number of mounting positions with 1/4" stud hole with 5/8" hole spacing, and 6 number of positions with 3/8" stud hole with 1" hole spacing
GB4B1028TPI-1	Telecommunications main grounding busbar (TMGB) with 28 number of mounting positions with 1/4" stud hole with 5/8" hole spacing, and 10 number of positions with 3/8" stud hole with 1" hole spacing
LTYK	Busbar label kit includes one printed tag and on flame retardant cable tie.

2.24 Vertical Grounding Strip Busbars for New Install Racks and Cabinets

A. Provides clean bond to any rack mounted equipment regardless of whether or not equipment has an integrated grounding terminal.

B. Bonds up to 45 RU per rack.

C. Comes in EIA Universal mounting hole pattern.

D. Complies with US and International grounding requirements.

E. Comes in threaded rail and cage nut versions.

F. Approved Manufacturers:

1. Panduit

G. Approved rack and cabinet mount vertical busbars for new installs:

Part Number	Description
RGS134-1Y	Grounding strip for use with threaded rails; 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
RGS134B-1	Grounding strip for use with cage nut rails; 78.70" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips
RGS13442-1	Grounding strip for use with threaded rails ; 73.70" (1.9m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three each, #12-24 x1/2" and M6 x12mm thread-forming screws.
RGS13448-1	Grounding strip for use with threaded rails; 83.90" (2.1m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
RGS13451-1	Grounding strip for use with threaded rails; 89.15" (2.3m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
RGS13452-1	Grounding strip for use with threaded rails; 90.90" (2.3m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.

RGS134B42-1	Grounding strip for use with cage nut rails; 73.40" (1.9m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.
RGS134B48-1	Grounding strip for use with cage nut rails; 83.90" (2.1m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.
RGS134B51-1	Grounding strip for use with cage nut rails; 89.15" (2.3m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.
RGS134B52-1	Grounding strip for use with cage nut rails; 90.90" (2.3m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.

2.25 Rack Bonding Conductor Kits (RBC)

A. Bonds the rack or cabinet to the telecommunications grounding busbar (TGB or TMGB).

B. Jumper kits available with both ends factory terminated to provide a bolt-on solution.

C. Jumper kits available with one end factory terminated to attach to the rack or cabinet; free end accommodates unique length requirements.

D. Engineered to comply with US and international grounding requirements.

E. Approved Manufacturers:

1. Panduit

F. Approved rack jumper (RBC) kits:

Part Number	Description
GJ672UH	Terminated on both ends for smaller telecommunications rooms where racks have individual connections directly to the TMB. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. Comes in lengths 72", 96", 120", 144", 168", 192:", 216", 240", 264", and 288". For other lengths substitute "72" in part number with desired length
GJS6120U	Terminated on one end for larger telecommunications rooms where racks are individually bonded to underfloor or overhead bonding

	backbone with an HTAP connection. One 120" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAW-L. For 180" length substitute "120" in part number with "180"
	ASSOCIATED HARDWARE FOR RBC KITS
HDW1/4-KT	Stainless steel mounting hardware for busbar; two 1/4-20 hex bolts, two 1/4-20 hex nuts, four 1/4 flat washers and two 1/4 Belleville compression washers. Mounting hardware for rack or cabinet; two #12-24 thread-forming screws and two M6 thread-forming screws.
HDW3/8-KT	Stainless steel mounting hardware for busbar; two 3/8-16 hex bolts, two 3/8-16 hex nuts, four 3/8 flat washers and two 3/8 Belleville compression washers. Mounting hardware for rack or cabinet; two #12-24 thread-forming screws and two M6 thread-forming screws
HDW1/4-A-KT	Stainless steel mounting hardware for busbar; two 1/4-20 hex bolts, two 1/4-20 hex nuts, four 1/4 flat washers and two 1/4 Belleville compression washers. Mounting hardware for rack or cabinet; two #10-32 thread-forming screws and two M5 thread-forming screws
HDW3/8-A-KT	Stainless steel mounting hardware for busbar; two 3/8-16 hex bolts, two 3/8-16 hex nuts, four 3/8 flat washers and two 3/8 Belleville compression washers. Mounting hardware for rack or cabinet; two #10-32 thread-forming screws and two M5 thread-forming screws

2.26 Electrostatic Discharge (ESD) Port Kits and Wrist Strap

A. For dissipating electro-static buildup prior to maintenance work on network equipment.

B. Accommodate standard ESD wrist strap 4mm plug.

C. Wrist strap provides rapid and continuous drain of electrostatic charge between a person and the surface to which the wrist strap is bonded, thus preventing damaging static discharge into equipment.

D. Can be mounted to front or back of rack or cabinet for convenient access.

E. Bent 45° to act as a hook to hold wrist strap when not in use.

F. Two-hole configuration provides anti-rotation and prevents loss of bond.

G. Barrel permanently marked with the protective earth (ground) symbol.

H. Engineered to comply with US and International grounding requirements.

I. Versions for threaded racks rails or cabinet cage nuts.

J. Approved Manufacturers:

1. Panduit

K. Approved ESD port kits:

Part Number	Description
RGESD2-1	For #12-24 or M6 rail fasteners: Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws
RGESD2B-1	For cage nut rail fasteners: Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, two cage nut bonding studs and two #12-24 bonding nuts
RGESDWS	Adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap.

2.27 Equipment Jumper Kits (Unit Bonding Conductor or "UBC")

A. Used to ground large, chassis-style rack mounted equipment that have built-in grounding pads or terminals.

B. Bond network equipment to grounding strip or grounding busbar.

C. Jumper kit available with both ends factory terminated to provide a bolt-on solution.

D. Jumper kit available with one end factory terminated to attach to the grounding strip or grounding busbar; free end accommodates unique equipment terminations.

E. Use jumpers with 90° bent lug, on grounding strip side, for high density grounding requirements up to one ground point per RU.

F. Use jumpers with 45° bent lugs on grounding strip side, for improved cable management.

G. Engineered to comply with US and International grounding requirements.

H. Approved Manufacturers:

1. Panduit

I. Approved equipment jumper (UBC) kits:

Part Number	Description
GJS6 series	#6 equipment jumper factory terminated on one end for switches, cabinets and 4 post racks. Exact part number depends on length
RGE series	Factory terminated jumpers that are terminated on both ends . Exact part number depends on AWG size, length and angle of two hole lugs

2.28 Surge suppressor jumper kit

A. Bonds power or data line surge suppressor to grounding strip or grounding busbar.

B. Both ends factory terminated to provide a bolt-on solution.

C. Engineered to comply with US and International grounding requirements.

D. Approved Manufacturers:

1. Panduit

E. Approved surge suppressor jumper kits:

Part Number	Description
SSGK-1	#10 AWG (6mm²) jumper; 24" (.61m) length; factory terminated on both ends; one-hole lug on surge suppressor to two-hole lug on grounding strip/busbar side; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws

2.29 Armored cable grounding kit

A. Provides a secure bond to the armor sheath on indoor and indoor/outdoor fiber optic cables at both cassette and enclosure ends.

B. Worm-gear design evenly distributes forces across the armor.

C. Made from steel and aluminum material is compatible with common armor for long term reliability.

D. Black insulating cover protects and hides the connection for an aesthetically pleasing work area.

E. Complies with industry requirements ensuring a high level of reliability and safety.

F. Approved Manufacturers:

1. Panduit

G. Approved armored cable grounding kits:

Part Number	Description
ACG24K	#6 AWG (16mm2) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover
ACG24K-500	#6 AWG (16mm2) jumper for armored cable diameter 0.85" (21.3mm) to 1.03" (26.2mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover
ACGK	Armored cable grounding kit. Contains one grounding terminal for #6 AWG grounding conductor, and one #10 mechanical clamp for cable diameters in 9/16" – 1 1/16" diameter range.

2.30 Miscellaneous Bonding Accessories:

A. Anti-oxidation Paste (contact aid) For Copper to Copper and Copper to Steel Connections.

B. Anti-oxidation Paste (contact aid) For Aluminum Pad-to-Pad or Thread-to-Thread Aluminum Connections.

C. Green thread-forming bonding screws for bonding smaller equipment on threaded rack rails through the equipment mounting flange.

D. Green bonding cage nuts from bonding smaller equipment on cage nut rails through the equipment mounting flange.

E. Thread forming screws for bonding two hole lugs to Rack Bonding Busbar (RBB) on threaded rack rails.

F. Green paint piercing grounding washers for assuring electrical continuity between painted parts of equipment racks as described in TIA 607-C Standard.

G. Bonding hardware kits (studs) for forming low-resistance bond between the rack or cabinet and painted rack mounted appliances and equipment.

H. Approved Manufacturers:

1. Panduit

I. Approved miscellaneous bonding/grounding components and accessories:

Part Number	Description
CMP-300-1	Contact aid (anti-oxidant paste) for copper-to-copper and copper-to-steel connections in 8 oz container. Operating temperature range -40°F (-40°C) to 350°F (177°C). Good for all voltages and suitable for grounding. Also may be used for anti-seizing thread lubricant
CMP-100-1	Contact aid (anti-oxidant paste) for pad-to-pad or thread-to-thread aluminum connections made on aluminum conductor in 8 oz container. Operating temperature range -40°F (-40°C) to 400°F (204°C).
RGTBSG-C	Green thread-forming bonding screw, #12-24 x 1/2" for mounting smaller equipment and bonding to rack/cabinet racks through equipment mounting flange
RGTBS1032G-C	Green thread-forming bonding screw, #10-32 x 1/2" for mounting smaller equipment and bonding to rack/cabinet racks through equipment mounting flange
CNB4K	Green bonding cage nut, includes 4 #12-24 bonding cage nuts (.06 – .11 thick panel) and 4 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket). Ideal for patch panel applications
CNBK	Green bonding cage nut, includes 50 #12-24 bonding cage nuts (.06 – .11 thick panel) and 50 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket)
RGTS-CY	Thread-forming grounding screw, #12-24 x 1/2" for bonding two-hole grounding lugs to rack/cabinet vertical busbars
RGTS1032-C	Thread-forming grounding screw, #10-32 x 1/2" for bonding two-hole grounding lugs to rack/cabinet vertical busbars
RGW-100-1Y	100 paint piercing bonding washers for 3/8" (M8) stud size; .875" (22.2mm) O.D.; provided with .16 oz. (5cc) of antioxidant.
TRBSK	Bonding stud kit for threaded #12-24 rail fasteners; includes 25 bonding studs and 50 bonding nuts for bonding painted equipment and appliances to rack/cabinet rails and vertical busbars
CGNBSK	Bonding stud kit for cage nut rail fasteners; includes 25 bonding studs and 50 bonding nuts for bonding painted equipment and appliances to rack/cabinet rails and vertical busbars

PART 3 EXECUTION

3.1 Installation

A. General:

1. This Specification document describes a generic enterprise communications bonding and grounding system for the construction of a complete and functioning grounding system. It is the responsibility of the installing contractor to adapt these general guidelines and principles to the requirements of the actual environments where the systems are to be implemented.
2. System shall provide equipment ground connections (bonds) from the premises entrance facility and outside-plant earthing system to each telecommunication room telecommunication ground busbar, through the racking systems to bond the network equipment.
3. Entire grounding link from equipment to earth should be visually verifiable except where hidden by walls, conduit or pathways.
4. Installing contractor shall label all elements of the communications bonding network according to guidelines defined in TIA-607-C and ANSI/TIA 606-B.
5. It is the responsibility of the installer to be knowledgeable of all previously cited Standards and Codes and to bring to the attention of Architect and Technology Consultant any conflicts or discrepancies to achieve a fully functioning, standards-compliant earthing system.

B. Telecommunications Bonding Backbone (TBB):

1. Bonding and grounding conductors may be insulated or un-insulated and shall not decrease in size as the grounding path moves closer to earth.
2. Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in TIA 607-C and applicable electrical codes.
3. Bonding Conductors should be continuous and routed in the shortest possible straight line path, avoiding changes in elevation and sharp bends.
4. TBB conductors shall be protected from mechanical damage and built so as to minimize splicing. Where splicing is unavoidable they shall be done using irreversible compression splices (C-TAPS) built to that purpose. See the "Materials" section of this document for appropriate compression splices.
5. TBB in multi-story buildings with multiple risers (multiple TBBs) shall employ a Backbone Bonding Conductor (BBC) or grounding equalizer (GE) between vertical grounding backbones at the top floor of the building and minimally at every third floor in between to the lowest floor level. The BBC shall be no smaller than the largest sized TBB.
6. Routing grounding conductors through ferrous metal conduit should be avoided, but if it is necessary due to building constraints, any grounding conductor running through ferrous conduit longer than 3 feet shall be bonded at the end using appropriately sized HTAP and Conduit grounding clamps as described TIA 607-C using appliances described for that purpose in the "Materials" section of this document.

7. Conductors used to bond TBB to conduit ends shall be of #6 AWG size or larger.
8. Conductor sizing shall be based upon project specification (drawings and notes) for that installation. These sizes are based on TBB length per TIA 607-C recommendations. Contractor shall bring to the attention of Architect and Technology Consultant anywhere TBB project specified sizing appears insufficient per the Table below:

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
20-26 (67-84)	3/0
26-32 (85-105)	4/0
32-38 (106-125)	250 kcmil
38-46 (126-150)	300 kcmil
46-53 (151-175)	350 kcmil
53-76 (176-250)	500 kcmil
76-91 (251-300)	600 kcmil
Greater than 91 (301)	750 kcmil

C. Entrance Facilities and Telecommunications Main Grounding Busbar (TMGB):

1. TMGB shall be located in the entrance facility, near the electrical panel to which it will be bonded but installed to maintain clearances required by applicable electrical codes.
2. TMGB shall be sized according to the anticipated number of bonded connections needed.
3. TMGB shall have tinned surface to restrain oxidation and be cleaned and antioxidant paste applied prior to fastening conductors.
4. Connectors on TBB which attach to TMGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
5. Building steel within six feet of the communications grounding system should be bonded into the system with appropriate hardware listed in "Materials" section of this document.
6. All cables containing a metallic shield or armor shall have that shield properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.

D. Telecommunications Rooms and Telecommunications Grounding Busbar (TGB):

1. Each telecommunications room shall have its own TGB to which equipment and dead steel (building steel and support structures) in that room are bonded.
2. The TGBs shall have a tinned surface to inhibit oxidation and be sized according to the anticipated number of bonded connections that will be needed.
3. TGBs shall be sized according to the anticipated number of bonded connections needed.
4. TMGs shall have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.

5. Connectors on backbone and rack/cabinet bonding conductors which attach to TGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
6. Building steel within six feet of the communications grounding system should be bonded into the system with beam clamps and other hardware appropriate to that purpose listed in "Materials" section of this document.
7. Racks and cabinets shall have individual Rack Bonding Conductors (RBC) bonding to the Telecommunications Equipment Bonding Conductor (TEBC) or underfloor "Supplemental Bonding Grid - DAISY CHAINING OR SERIAL CONNECTIONS OF ONE RACK OR CABINET TO ANOTHER WILL NOT BE ACCEPTED.
8. Rack Bonding Conductors (RBC) or above rack row grounds (TEBC) shall be installed to maintain a minimum of 2" separation from all other types of cable - power or communications.
9. To maintain this segregation of cables some telecommunications rooms may lend themselves to the installation of Auxiliary Conductor Brackets for routing bonding conductors outside of, yet parallel to ladder rack or basket tray. See "Auxiliary Brackets" in "Materials" section of this document.
10. Bonding conductor support systems like auxiliary brackets shall be spaced no further apart than three foot intervals.
11. All cables containing metallic shielding or armor shall be properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.

E. Bonding within Racks and Cabinets:

1. Racks and Cabinets shall be bonded into the communications bonding network with conductors of #6 AWG or larger.
2. Racks, cabinets and similar enclosures shall not be attached serially (daisy-chained) but must have individual RBC into the grounding system.
3. Newly installed racks and cabinets shall have vertical grounding busbars installed along one rail to provide clean bonding landing point for all rack mount equipment. For part numbers vertical busbars see "Materials" section of this document. Grounding busbars shall not be isolated from the rack or cabinet.
4. All painted components of racks/cabinets shall be assembled using serrated grounding washers and thread-forming screws to ensure electrical continuity between the different structural components of the rack/cabinet.
5. Larger equipment (chassis switches) with integral grounding terminals or pads shall be bonded to the vertical busbar with equipment grounding kits attached to those terminals and bonding them to the rack-mounted busbars. For kit part numbers see the "Materials" section of this document.
6. Anywhere two metallic surfaces are to be bonded, contractor shall clean the contact areas of paint or oxidation using abrasive pads, and apply film of anti-oxidation compound between surfaces prior to bonding.
7. All cable fittings shall be of two-hole (LCC series) compression-type. Mechanical screw-lugs on racking systems will not be accepted and must be removed and replaced at contractor's expense.

8. All screws used to affix compression lugs to rack-mounted vertical busbars shall be of the thread forming type made specifically for electrical bonding.
9. Smaller equipment (servers, TOR switches) not having integral grounding pads must be bonded to the rack through the equipment mounting flanges using green thread-forming grounding screws with serrations under the head to cut through paint, coatings and oxidation that may be present on the equipment flange. Such equipment shall have minimally one grounding screw per piece of equipment.
10. ESD (electro-static discharge) ports and wrist straps shall be provided minimally every other rack or bay to be within reach of any active equipment. On larger 4-post racks or cabinets - ESD ports and wrist straps shall be installed on the front and back to be accessible when servicing any active equipment.
11. As a condition of employment, any internal or contracting technicians servicing active equipment must be wearing a properly grounded wrist strap to dissipate ESD charges prior to touching any active equipment.

F. FIELD QUALITY CONTROL

1. Contractor shall verify the use of all appropriate bonding accessories in the racking systems such as grounding washers, thread-forming grounding screws and the presence of electro-static discharge ports and wrist straps within reach of all equipment to be maintained.
2. Contractor is responsible for visually verifying sizing and sound installation of the telecommunications bonding backbone including presence of properly sized and installed grounding equalizer conductors between backbones contained in separate risers.
3. Inspecting Contractor shall verify that any conduit longer than 3 feet through which a grounding conductor passes is properly bonded to the grounding conductor as described in this document.
4. During inspections contractor shall verify compliance with all stipulations specified in this document and compliance with all regulatory references (Standards and Codes) cited.
5. All opens or gaps in the bonding system during final inspections will be recorded in the inspection report and remedied.
6. During inspections, contractor shall check all grounding and bonding system conductors and connections for tightness and proper installation, including checking proper dies were used on compression taps and fittings by checking embossed die numbers on those connections.
7. Architect and Technology Consultant may request a test of 10% of bonded connections within the grounding system with a volt-ohm meter. Resistance tests taken on either side of a compression or exothermic bond shall be less than .2 (2/10) of one ohm in resistance.
8. Bonded joints to be tested may be random or individually tagged by a representative of Architect or Technology Consultant.
9. Contractor shall Test system at bonded points indicated and provide results in report form.
10. Based upon test results, Architect and Technology Consultant reserves the right to request testing on 100% of exothermic and compression bonds within the installed grounding system.

11. All bonded connections failing the test described above shall be remedied and retested by the installation contractor at contractor's expense.

END OF SECTION

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SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Provisions and Supplementary Conditions, Specification Sections, apply to this and the other sections of Division 27.

B. This section is a Division 27 BASIC section and is a part of each Division 27 section.

1.2 SUMMARY

A. This Section includes secure support from the building structure for technology items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.

B. All support shall utilize threaded fasteners for all technology/attachments

1. Exception:
   a. Spring steel fasteners may be used in lieu of threaded fasteners only for ¾” raceways above suspended ceilings.

C. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. C-clamps
2. Clevis hangers
3. Conduit straps
4. I-beam clamps
5. Lead expansion anchors
6. Riser clamps
7. Round steel rods
8. Toggle bolts
9. Wall and floor seals

D. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly or as specified in Division 26.

1.3 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Supplementary Conditions Specifications Sections.

1. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve and seal.
2. Where multiple products are shown on one cut sheet, circle product to be used.
3. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings requires, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Contractor Qualifications: Firm shall have at least 3 years of successful installation experience with projects utilizing electronic/electrical supporting device work similar to that required for this project.

C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of supporting devices.

D. MSS Compliance: Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.

E. UL Compliance: Provide components that are UL listed and labeled.

F. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe and cable.

G. Components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer, or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.

B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.

C. Where proprietary names are used, whether or not followed by the words "or as approved", they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

D. Where the Contractor proposes substitute equipment, contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work, shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Provide supporting devices that comply with manufacturer's standard materials. Install in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option.

B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installations of supporting devices.

1. Support all technology cables a minimum of every 5ft. with J-hooks, unless other supports are available.
2. Cables shall be bundled in groups of 24 cables maximum.
3. Regardless of the size of the J-hooks, no more than (1) bundle of 24-cables may be placed within a single J-hook.

C. Coordinate with the building structural system and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

D. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.

E. Obtain approval from the Architect before drilling or cutting structural members.

F. Install surface-mounted cabinets and panels with minimum of four anchors.

3.2 MISCELLANEOUS SUPPORTS

A. Support miscellaneous technology components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panels, control enclosures, pull boxes, junction boxes and other devices.

3.3 FASTENING

A. Unless otherwise indicated, fasten technology items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panels, boxes and control components in accordance with the following:

B. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

C. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Technology Consultant immediately. Fill all holes that are not used.

D. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

3.4 TESTS

A. Test pull-out resistance of one of each type, size and anchorage material for the following fastener types:

B. Expansion anchors.

1. Toggle bolts.
2. Powder-driven threaded studs.

C. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain and submit the Structural Engineer’s signed approval before transmitting loads to the structure. Test to 90% of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION 270529

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SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTIONS INCLUDE

A. Continuous, rigid, welded steel or stainless steel wire mesh cable management system.

B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Related Sections include the following:

1. Section 270100 – Operations and Maintenance of Communications Systems
2. Section 270500 – Common Work Results for Communications
3. Section 270526 – Grounding and Bonding for Communications Systems
4. Section 270529 – Hangers and Supports for Communications Systems
5. Section 271100 – Communications Rooms Equipment Fittings

B. References:

1. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
2. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
3. ANSI/NFPA 70 (2005) – National Electrical Code (NEC)
4. TIA 569-D (1998) – Commercial Building Standard for Telecommunications Pathways & Spaces
5. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
6. ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
7. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
8. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

9. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

1.4 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Procedures.

B. Product Data: Submit manufacturer’s product data sheets for cable tray indicating dimensions, materials, and finishes, including UL Classification and NEMA/CSA Certification.

C. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details.

D. Design Calculations: Verify loading capacities for supports.

E. Coordination Drawings: Include floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Data presented on these drawings are as accurate as preliminary surveys and planning can determine. Field verification of all dimensions, routing, etc., is directed.

F. Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.

G. Submit manufacturer’s certification indicating ISO 9001 quality certified.

H. Submit training procedure for certifying cable tray installers.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.

1. The Terms “Classified” pertaining to cable trays (rather than “Listed”) and "Labeled": As defined in NFPA 70, Article 100, including painted trays.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.

D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.

E. Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide CSA/US Certificate and labels.

F. Provide documentation of the following certifications:

1. ISO 9001 quality certification.
2. American Bureau of Shipping (ABS) Product Design Assessment certification.
3. E 90 Fire Testing certification.
4. VDE certification.

1.6 COORDINATION

A. Coordinate layout and installation of cable tray with other installations.

1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
2. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by the following:

1. Cablofil, Inc., 8319 State Route 4, Mascoutah, IL, 62258. Phone: (618) 566-3230. Toll-Free: (800) 658-4641. Fax: (618) 566-3250. Website: www.cablofil.com. Email: Info@cablofil.com.

2.2 MATERIALS AND FINISHES:

A. Cable Tray Materials: select one of the following:

1. Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

B. Cable Tray Finishes:

1. Finish for Carbon Steel Wire after welding and bending of mesh; select one of the following:
   a. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
2. Finish for Stainless Steel Wire: According to ASTM B 380.

C. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray (including UL Classified painted tray) acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.

D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.

1. Straight Section Lengths: 120 inches (3,000 mm).
2. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
3. Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable insulation and installers' hands.
4. Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions and Item 2.3.
5. FlexTray Cable Tray Size:
   a. Depth: Cable tray depth will be 4 inches:
   b. Width: Cable tray width will be 6, 8, 12, 16, 18, 20 & 24 inches (unless otherwise shown on drawings):
   c. Length: Cable tray section length will be 120 inches (3000mm) unless otherwise shown on drawings.
   d. Fill Ratio: Cable tray may be filled to total fill capacity per NEC. Minimum 40% spare capacity recommended accommodates future cabling changes or additions.
   e. Load Span Criteria:
   f. Cable tray will be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8 ft support span, according to load tests of standard shown in Item A above.
6. Cablofil cable basket/tray part numbers:
   a. CF 105/150: 4 inches height x 6 inches width x 120 inches length
   b. CF 105/200: 4 inches height x 8 inches width x 120 inches length
   c. CF 105/300: 4 inches height x 12 inches width x 120 inches length
   d. CF 105/450: 4 inches height x 18 inches width x 120 inches length
   e. CF 105//500: 4 inches height x 20 inches width x 120 inches length
   f. CF 105/600: 4 inches height x 24 inches width x 120 inches length
   g. Or Approved Equals

2.3 CABLE TRAY SUPPORTS & ACCESSORIES

A. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports will include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting; installation time is reduced; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings.

1. FAS system support methods to mount from ceiling and wall structures with 1/4", 3/8" or 5/8" threaded rod, where applicable. Select one of the following support accessories:
   a. FASP trapeze hung supports for tray in ceiling and/or wall mounted applications. For trapeze hung installations, use a FAS Profile that is 4" longer than the tray width.
   b. FASL supports for tray in wall-mounted applications
   c. Center hung, single threaded rod supports (i.e., Cablofil FASPCH) shall not be used.
2. Splices including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer. Select one of the following splicing methods, if applicable:
   a. UL: Classified FTSTLC Tab-Loc Connectors: No hardware required
   b. UL Classified FTSCH: Connecting Hardware Swaged set for splicing, turns, bends and tees
   c. UL Classified SPLICE BAR Universal Splice Bar: Cut & bend to fit any configuration]
   d. Preclick Splice: Bolted connection optional]
   e. UL Classified FTSBK Splice Plate: Bolted connection
   f. UL Classified CE 25 & CE 30 Square Splice Washers: Use with EZ BN ¼" Nut & Bolt
   g. UL Classified CE 40 Square Splice Washer: Use with EZ BN ¼" to splice trays on bends, adjustable tees
   h. FASLock Splice: For sweeps and bends with tray 12" (300mm) and wider.
   i. UL Classified 90 DEGREEKIT: For Tees and 90s
   j. UL Classified RADT90 kit: For 5-1/2" radius Tees and 90s
   k. Cable Routing Accessories:
   l. Dropout: Bolt to tray; slotted design.
   m. Cablexit: No additional hardware needed.
   n. GROUND BOLT: Grounding Clamp to ground cable tray.

2.4 EQUIPMENT GROUNDING CONDUCTOR FUNCTION & GROUNDING

A. UL Classified cable trays (including painted tray) may act as Equipment Grounding Conductors.

1. Use UL Classified splicing methods to ensure cable tray is electrically continuous and bonded as recommended by COOPER B-Line.
   a. Ground cable trays at each joining section and end of continuous run.
2. Test cable tray system per NFPA70B, Chapter 18 to verify grounding less than 1 ohm.
3. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp. COOPER B-Line GROUND BOLT.

PART 3 EXECUTION

3.1 EXAMINATION:

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

1. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
   a. Cut cable tray wires in accordance with manufacturer’s instructions.
   b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
   c. Remove burrs and sharp edges from cable trays.
2. Certified Installers: Cable tray installers must have successfully completed Manufacturers Certified Installer program.
3. A minimum of 9-inches shall be observed between the cable supports and the finished ceiling.
4. A minimum of 12-inches shall be observed above the cables and cable supports.
5. A minimum of 12-inches shall be observed on one side of the cable supports.

END OF SECTION 270536

SECTION 271100 - COMMUNICATIONS ROOMS EQUIPMENT FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

1.2 SUMMARY

A. This Section includes the following:

1. Entrance protection for copper
2. Floor-standing equipment racks
3. Cable management
4. Terminal blocks and patch panels
5. Rack-mount power strips

B. Refer to following Specification Sections:

1. Division 6 Section “Rough Carpentry” for wood framing and blocking for installation of wall-mounted equipment racks.
2. Division 7 Sections for fire-stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Sections for supports, anchors, identification products, electrical service and connections.

C. Provide cabinets and racks in accordance with the Contract Documents. Where conflicting data is indicated, verify mounting and equipment requirements prior to ordering.

D. This section contains specific parts selected by Owner and Technology Consultant. In the event that the parts specified are not available, Owner and Technology Consultant shall be contacted to specify replacements.

1.3 COORDINATION

A. This contractor shall be responsible for all coordination with the general and electrical contractor and data and voice vendors to provide a complete operational system.

B. Coordinate layout and installation of equipment racks with adjacent construction.

1.4 SUBMITTALS

A. Product Data: Provide product data submittals for all supplied equipment, and for equipment as identified on Sheet T-001 Contractor Responsibility Matrix

B. Shop Drawings: Show fabrication and installation details of components for cabinets, equipment racks, and their associated parts and pieces to make a complete system.

C. Show rack elevations for review and approval by the Owner and Technology Consultant.

D. Allow sufficient time in project scheduling for Owner and Technology Consultant review.

E. Submittals shall be checked by the supplier and made as complete systems including all required accessories and any special tools.

F. Manufacturer's installation and maintenance instructions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of enclosure through one source from a single manufacturer.

B. All work shall be in accordance with the latest edition of all applicable State, and Federal regulations and codes. Further, all work shall also be in accordance with EIA/TIA Standards, the BICSI TDMM manual, latest edition and with the manufacturer’s recommendations.

1.6 SEQUENCING AND SCHEDULING

A. Sequence all work to support the installation of the structured cabling system, electrical work and all cable tray systems installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available manufacturers are listed in subparagraphs for each Part 2 article below.

B. Proposed substitutions shall be submitted WITH THE BID and must be approved by the Owner and Technology Consultant.

C. Requests for substitution are only permitted for materials specified with an "or approved equivalent" clause or other language of same effect in the Contract Documents.

2.2 ENTRANCE PROTECTION

A. Not required for project, entrance protection is existing to remain.

B. Shall be wall-mounted 110-type.

1. Not required for project, existing to remain.

2. Circa Telecom, Part #1880ENA1/NSC-50 or approved equivalent.

C. Acceptable manufacturers are:

1. Avaya
2. Circa Telecom
3. Marconi
4. TII Network Technologies
5. Approved equivalent

D. All protection modules are to be solid state.

E. Acceptable modules are:

1. Circa Telecom, Part #4B1S-300 or approved equivalent

2.3 RACKS

A. Shall be provided by Owner’s preferred structured cabling vendor.

B. Floor Distribution Frame: For rack mounted installations in Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Rooms, use a 7-foot high 19-inch 2-post rack.

C. Manufacturers (racks and related equipment):

1. Chatsworth Products Inc (CPI), or approved equal.

D. The racks shall:

1. Be made by an ISO 9001 and 14001 Certified Manufacturer.
2. Have cable access holes on side rails, which allow cables to be routed between adjacent racks.
3. Have standard 19-inch ANSI/EIA-310-C mounting holes having a full 45 RU on front and back of rails.
4. The racks shall have floor mounting holes and a ground lug for 0-6 gauge ground cable provided.

E. Manufacturer:

1. CPI/Chatsworth Products Inc., Part #55053-703 or approved equal.

F. Ensure product submittal includes all accessories and ensures system compatibility.

2.4 VERTICAL CABLE MANAGERS

A. Shall be provided by Owner's preferred structured cabling vendor.

B. The racks shall have vertical cable management channels 6"W x 8"D x 7'H. Channels will be located between racks and on the end of each row. The channel shall include cable retainers, which can be hinged left or right and be located in any position along the channel.

C. The vertical cable managers shall utilize black grommets at all cable openings, including unused cable openings.

D. Manufacturer:

1. CPI/Chatsworth Product Inc., Part #30092-703 or approved equal.

E. Ensure product submittal includes all accessories and ensures system compatibility.

2.5 HORIZONTAL CABLE MANAGER

A. Shall be provided by Owner's preferred structured cabling vendor.

B. Provide horizontal cable managers, 2 RU in height. Provide up to one horizontal cable manager per 48-port patch panel. Install in rack as coordinated with Owner.

C. Manufacturer:

1. CPI/Chatsworth Product Inc., Part #30130-719 or approved equal

2.6 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Shall be provided by Owner.

B. Provide rack-mounted UPS units, minimum 2.2kVA.

1. APC Smart-UPS XL 2200VA RM 3U 120V; provide one per rack.

2.7 RACK-MOUNT POWER STRIPS

A. Shall be provided by Owner's preferred structured cabling vendor.

B. Provide rack-mounted power strips 1 RU in height with 8 outlets, and twist-lock plug with 10' cord.

C. Provide one power strip per rack. Verify exact location in each 2-post rack with Owner prior to installing any other MDF/IDF rack-mount equipment.

D. Manufacturer:

1. CPI/Chatsworth Product Inc., Part #12816-706.

2. Verify product technical specifications with supplied power circuits and confirm final requirements with Owner prior to procurement.

2.8 CABLE LADDER RUNWAY

A. Shall be provided by Owner's preferred structured cabling vendor.

B. Overhead cable runway shall be provided within equipment rooms for horizontal cable management, as shown on the drawings.

C. Provide cable runway radius drops, pathway dividers, junctions, splices, supports, and all necessary appurtenances for a complete installation.

D. Cable runway mounted over racks shall be designed specifically for use over 19" wide racks and vertical cable managers wherein the runway cross-members are spaced to align over the vertical cable channels.

E. Use CPI or approved manufacturers:

1. CPI Part #31472-706 where 6” ladder is indicated on drawings
2. CPI Part #31472-712 where 12” ladder is indicated on drawings
3. CPI Part #31472-718 where 18” ladder is indicated on drawings
4. CPI Part #31472-724 where 24” ladder is indicated on drawings

F. Cable runway for telecommunication room usage other than specified above shall be:

1. CPI Part #10250-704 where 4” ladder is indicated on drawings.
2. CPI Part #10250-706 where 6” ladder is indicated on drawings.
3. CPI Part #10250-709 where 9” ladder is indicated on drawings.
4. CPI Part #10250-712 where 12” ladder is indicated on drawings.
5. CPI Part #10250-715 where 15” ladder is indicated on drawings.
6. CPI Part #10250-718 where 18” ladder is indicated on drawings.
7. CPI Part #10250-724 where 24” ladder is indicated on drawings.

PART 3 EXECUTION

3.1 LIGHTNING PROTECTION

A. All copper cables, either multi-pair or coaxial, are to be terminated on lightning protection within 50 feet of the entrance into the building.

B. All pairs of inter-building twisted pair copper cable are to be protected on both ends to lightning protection blocks.

C. Lightning Protection Blocks are to be grounded to the nearest Telephone Main Grounding Bar (TMGB) or Telephone Grounding Bar (TGB).

3.2 RACKS

A. Racks shall be provided and installed by Owner’s preferred vendor.

B. Preparation

1. Coordinate requirements for riser bases, raised floor riser feet, anchors, bracing, and blocking to ensure adequate means for installation of racks/cabinets.
2. Coordinate requirements for electrical cable pathways from overhead cable trays and management systems.

C. Installation

1. Install racks in compliance with manufacturer's written instructions and shop drawings.

2. Floor-standing racks/cabinets in the telecommunication rooms shall be securely attached to the concrete floor using minimum 3/8” in diameter hardware utilizing an approved length.
   a. Contractor shall abide by any regional seismic requirements for rack type and installation.
3. Install equipment racks at locations and heights indicated on Drawings. Rows of racks/cabinets shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack, unless otherwise indicated on Drawings. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks/cabinets. Where racks/cabinets are shown side by side, securely connect together using manufacturer’s ganging hardware to provide a stable system. Supply all miscellaneous parts and pieces to make a complete system.
4. Rack and runway installation shall comply with local seismic bracing requirements.
5. All racks/cabinets shall be grounded to the ground bus bar in accordance with the drawings and other Sections of this document.
6. Rack mount screws not used for installing patch panels, keys and other hardware shall be bagged and left with the rack upon completion of the installation.
7. Horizontal wire managers shall be installed between patch panels as described in Section 271600. The contractor shall provide an equal number of wire managers in the electronics racks as was required for the patch panels, and install them in the configuration as coordinated with Owner.
8. Vertical cable managers shall be installed on both sides (left and right) of each rack in the telecommunications rooms.
9. Horizontal cable jumper tray shall be in the uppermost position and have the radius section adjusted to transition optical fiber to the vertical cable channel.

3.3 OWNER FURNISHED EQUIPMENT

A. Other Owner furnished/installed IT equipment for the Project includes:

1. PoE network switches
2. Active network electronics equipment
3. Firewalls and routers
4. Network servers/ software
5. Wireless access points and server
6. VoIP telephones and server
7. Emergency alert beacons

END OF SECTION 271100

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SECTION 283111 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY:

A. Extend existing Voice system as indicated on the drawings.

B. Provide system suitable for type and occupancy as defined by local Building Code, as approved by local Fire Marshal, local authority having jurisdiction, and as approved by the Director of Facilities Development. Drawings indicate general design intent and do not indicate all equipment or devices or the full extent of the System. Provide complete design of the Fire Alarm System.

C. Provide an Analog/Addressable System which is defined as a system in which initiating devices and interface modules transmit their address via a binary or multiplex code over a common pair of wires. This address is converted to an English language display giving a custom description for each reporting device. In addition, the system will provide analog information about the sensitivity of each photoelectric, and heat sensing device. The system control panel will maintain a log of this information which can be reviewed on demand. The system will also provide a maintenance alert when the sensitivity of any detector has been outside of a preset range for a period of 24 hours.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products have been in satisfactory use in similar service for not less than 5 years.

Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project.

1. Firm with manufacturer's factory trained personnel.
2. Firm with factory authorized service organization and spare parts stock within 50 miles of the project and with a 24 hour response time.
3. Installation shall be accomplished by or supervised by NICET II or higher.

B. Codes and Standards

1. Each and every item of the fire alarm system shall be listed as the product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratory, Inc. (UL) and shall bear the UL label on all devices, appliances and panels comprising the system. All control equipment shall be listed under the category UOJZ as a single control unit and cross listed with the base loop fire alarm system. Partial listings shall be unacceptable.
2. The complete installation shall conform to the applicable sections of NFPA and Local Code Requirements, and the National Electrical Code with particular attention to article

760. All control equipment must have transient protection to comply with UL 864 requirements or Standard #497B as applicable.
3. FM Compliance: Provide fire alarm systems and accessories which are FM approved.
4. The fire alarm system and devices shall comply with ADA 1990 and UL 1971 requirements.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's technical product data including specifications, data sheets, wiring diagrams, equipment ratings, dimensions, finishes, and description of system operation.

C. Shop Drawings: Provide shop drawing submittal for approval by the local Fire Department and/or The Authority having jurisdiction. The Contractor shall arrange to have the Fire Alarm System shop drawing submittal prepared, sealed, and signed by a professional engineer and NICET III or NICET IV in Fire Alarm Systems if/as required by the authority having jurisdiction. Preparer shall assume the duty of Engineer of Record for the Fire Alarm System design. Provide shop drawings showing system components, including panels and cabinets, locations, quantities, and full schematic of system wiring showing conductor routings and quantities, and connection details. Provide updated room names and numbers that match the names and numbers as labeled at the building. Room names and numbers shown on the contract documents are not necessarily those that are currently being used in the building. The fire alarm manufacturer shall coordinate with the contractor and owner on existing and new work and survey the site on existing work to identify the proper names and numbers. All conduit routing must be submitted to, and accepted by, the Architect/Engineer. Shop drawing documents must be submitted simultaneously with sprinkler system documents and prior to installation.
This information shall be submitted on 1/8 inch = 1foot scale building floor plans. No other systems shall be included on these plans. Reproduction of contract drawing will not be acceptable. The following information shall be included in the shop drawings:

1. Occupancy group and use.
2. Number of stories.
3. Indicate extent of building sprinkler system.
4. Indicate addition to/modifications of existing system.
5. One-line diagram showing/indicating number of devices and appliances per zone/circuit.
6. Wire sizes, color coding, type(s) and voltage drop calculations.
7. Indicate annunciation method and include graphic zone map.

D. Submit manufacturer's installation instructions, including outlet or back box requirements for each piece of equipment.

E. Submit manufacturer's certificate that system meets or exceeds specified requirements.

F. Submit sequence of operation and verification of system operation by manufacturer or his authorized representative.

G. Submit back-up battery calculations.

H. All shop drawings, battery and voltage drop calculations shall be submitted to the authority having jurisdiction for review after review by the Architect/Engineer.

I. Submit graphic annunciator and/or map layouts for review by the Architect/Engineer prior to fabrication.

J. Indicate whether fire alarm system is required or non-required and list code sections required by and applicable to.

K. List all variances and attach as required.

L. Include brief description of scope of work.

M. Submit Zone schedule.

N. Submit device address schedule.

O. Submit interior and exterior front elevations of the FACP and exterior front elevations of other panels.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Handle fire alarm equipment carefully to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new.

B. Store fire alarm equipment in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

1.5 EXTRA MATERIALS:

A. General: Provide extra materials as listed below in addition to that required to complete the work. The additional stock shall not be used unless specifically authorized by the Owners Representative.

B. Lamps: Furnish spare/replacement lamps and LED’s amounting to not less than three (3) lamps of each type and of each color.

C. Devices:

1. Furnish spare/replacement detection bases amounting to 5 percent of the quantity installed by this work, but not less than two (2) of each type, including duct detector housings.
2. Furnish spare/replacement detectors amounting to 5 percent of the quantity installed by this work, but not less than two (2) of each type.
3. Furnish spare/replacement adaptor modules and relays amounting to 5 percent of the quantity installed by this work, but not less than one (1) of each type.
4. Furnish spare/replacement speakers/horns, combination speaker/horn/strobe units, and strobe units amounting to 5 percent of the quantity installed by this work but not less than one (1) of each type.

1.6 OPERATION:

A. The existing system operation shall be maintained and extended.

B. The system alarm operation subsequent to the alarm activation of any manual station, or sprinkler flow switch shall be as follows:

1. All audible alarm indicating appliances shall sound a distinctive and continuous fire alarm signal until silenced by the alarm silence switch at the control panel or at the remote annunciator.
2. All visible alarm indicating appliances shall flash continuously until the system is reset. Visual alarm devices shall continue to operate when audible devices are silenced, when allowed by the AHJ. Any subsequent zone alarm shall reactivate the alarm indicating appliances.

C. The activation of any system addressable 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 addressable smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by zone.

1. The control panel shall have the capability to display the number of times (tally) a zone has gone into a verification mode. Should this mode verification tally reach a pre-programmed number, a trouble condition shall occur.

1.7 SUPERVISION

A. There shall be supervisory service initiation device circuits for connection of all sprinkler valve supervisory switches (tamper). Device activation shall cause a supervisory alarm at the control panel.

B. There shall be independently supervised and independently fused indicating appliance circuits for alarm speakers and flashing alarm lamps. Disarrangement conditions of any circuit shall not affect the operation of other circuits.

C. Auxiliary manual control shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.

D. Each independently supervised circuit shall include a discrete LCD readout to indicate disarrangement conditions per circuit.

E. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.

F. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.

G. The System Modules shall be electrically supervised for module placement. Should a module become disconnected the system trouble indicator shall illuminate and the audible trouble signal shall sound.

H. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide fire alarm systems by the following:

1. Honeywell Silent Knight

B. Fire Alarm Cable

1. West Penn
2. Belden
3. Annixter

2.2 FIRE ALARM AND DETECTION SYSTEMS:

A. General: Provide complete fire alarm products of types, sizes and capacities indicated, which comply with manufacturer's standard design, materials, components; construct in accordance with published product information, and as required for complete installation. Provide fire alarm and detection systems for applications indicated.

B. Wiring System Materials: Provide basic wiring materials which comply with Division-26 sections; "Raceways", Wires and Cables" and "Electrical Boxes and Fittings".

1. Provide wire and cable in accordance with requirements of manufacturer. Wire insulation shall comply with NEC Article 760.
2. Provide individual solid copper conductor sizes AWG #14, or larger.
3. Provide multi-conductor cables for wire sizes smaller than AWG #16.
4. Provide conductors which are UL listed for the installation and location, and approved for fire alarm usage.
5. Initiating circuits shall be color coded red for positive, red with black stripe for negative. Indicating circuits shall be color coded red with yellow stipe for positive, red with brown stripe for negative.
6. All conductors shall be numbered and their numbers shall correspond to the terminal block numbering they are connected to. Provide conductor wiring and terminal block numbering.
7. Wiring styles shall be as follows: Class B-IDC, Class B, Style 4-SLC, Class B-NAC. Style D-IDC between buildings.
8. Provide multiple audible zones and alternate zones per floor.

C. Power Requirements:

1. The control panel shall receive 120 VAC power via a dedicated circuit. The system shall include an integral, transient voltage surge suppression device (SPD) on the incoming 120- volt power. SPD device shall be UL 1449 rated for 380 volts/Type B.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period

of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.

3. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.

2.3 FIRE ALARM CONTROL PANEL:

A. Provide any additional components as required for the existing fire alarm control panel.

2.4 ADDRESSABLE DEVICE TYPES:

A. General: Devices will be located as shown on the drawings. The location of addressable devices will be selected to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.

B. Environmental Compensation Analog Sensors:

1. Smoke sensors shall be a smoke density measuring device having no self-contained alarm set point. The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to stored values. The control panel shall maintain a moving average of the sensors smoke chamber value. Systems that do not automatically maintain a constant smoke obscuration sensitivity for each sensor by compensating for environmental factors are deemed unacceptable.
2. The detector shall automatically indicate when an individual sensors needs cleaning. When a sensor's average value reaches a predetermined value, a "Dirty Sensor" trouble condition shall be audibly and visually indicated at the control panel. 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.
3. The control panel shall automatically perform a daily self-test on each sensor. Checking the electronics in the sensor's base ensures the accuracy of the values being transmitted to the control panel. A sensor that fails the self-test will cause a "Self-Test Abnormal" trouble condition at the control panel. A sensor self-test which must be manually initiated by the operator shall not be acceptable.

C. Addressable Detector Bases: All addressable smoke and heat detector heads will plug into their bases. The base will contain electronics that communicate the detector status (normal, alarm, trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Detector heads (smoke or heat) must be interchangeable. Upon removal of the head, a trouble signal will be transmitted to the control panel.

D. Photoelectric Detector Head: Photoelectric type detectors shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry. The detector shall fit into an addressable base that is common with both the heat and photoelectric type detectors.

E. Pull Stations: Pull stations shall contain electronics that communicate the station’s status (alarm, normal) to the control panel over two wires which also provide power to the pull station. The address will be set on the station. They will be manufactured from high impact red Lexan. Station will mechanically latch upon operation and remain so until manually reset

by opening with a key common to all system locks. Pull stations will be single/double action. The front of the station is to be hinged to a back-plate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. The addressable manual station shall be Underwriters' Laboratories Inc. listed for operation with the control panel.

F. Duct Smoke Detectors: The detector shall be non-polarized 24VDC type which is compatible with the fire alarm panel and obtains its operating power from the supervisory current of the addressable loop. The detector head shall be the same as the addressable photoelectric detector heads used in the rest of the system. Provide duct detectors compatible with the air velocities within the duct to be installed (i.e. for low velocity ducts, provide an in-duct style detector). It shall be possible to test the detector by use of a remote alarm test switch. The duct detector housing shall contain the addressable electronics necessary to communicate with the control panel. For maintenance purposes, it shall be possible to clean the sampling tubes by access through the detector housing. To minimize false alarms, voltage and transient suppression techniques shall be employed as well as automatic alarm verification circuitry and insect screens.

1. Each duct detector shall be provided with a remote alarm LED indicator and a Magnet Type RTS. Plates shall be labeled with the name of the device/equipment served.
2. Interlock each fan with its associated duct detector.
3. Provide access door(s) for in-duct style duct detectors.

G. Adaptor Module: Adapter Modules shall be used for monitoring of water flow, valve tamper, non-addressable detectors, and for control of smoke dampers, door holders, and other output control functions. Adapter Modules will be capable of mounting in a standard electric outlet box. Adapter Modules will include cover plates to allow surface or flush mounting. Adapter Modules will receive their 24VDC power from a separate two wire pair running from an appropriate power supply. There shall be two types of devices: Type 1; Monitor Adapter Modules - for conventional 2-wire thermal detector and/or contact device monitoring with Class B or Class A wiring supervision. Type 2; Control Adapter Modules - for signals, speakers, fire fighter phone jacks and other device control with Class B or Class A wiring supervision.

2.5 ALARM SIGNAL DEVICES:

A. Fire Alarm Speaker/Strobe Combination: Provide high impact resistant red LEXAN speaker/strobe combination devices as shown on the plans. Each assembly shall consist of two independent devices which are manufactured as compatible with each other and with the control equipment. Each assembly shall provide a terminal strip or wire leads for true in-out wiring connections. The strobe unit shall have a candela-second rating in compliance with ADA requirements and be rated at 24 VDC.

1. Housings shall be white unless otherwise noted.
2. Exterior-mounted devices shall have red housing.
3. Strobes shall be clear with red letters "ALERT" on two sides.
4. Provide wall mounting as shown on the plans. Verify manufacturer mounting requirements prior to rough in.

B. Individual Strobe Unit: Provide strobe units mounted where shown. Units shall match those used in the combination horn/strobe or speaker/strobe specified.

C. Where multiple strobe units are visible from a single location and the potential visible flash rate is 5 hz or more, provide synchronizing modules and strobes compatible for synchronizing as required. Provide additional wiring, conduit, and power supplies as necessary.

D. Speakers have been located on the drawings. It is the Contractor's responsibility to provide adequate coverage to achieve the required 15 dBA above ambient at all locations throughout the building. If locations shown are inadequate, provide additional speakers/horns on shop drawing submittal. Additional speakers/horns will be added at no additional cost to the contract including conduit wiring, power supplies, etc. System shall meet NFPA 72 Intelligibility Standards required by AHJ.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which fire alarm systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 IDENTIFICATION:

A. Provide electrical identification in accordance with Division-26 section on Electrical Identification. SLC and NAC Devices shall be labeled with System Device Address and EOL locations shall be identified at each EOL device.

3.3 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:

A. Install all wiring in raceways. Raceways shall be red pre-finished conduit.

B. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 26 sections; “Raceways”, “Wires and Cables”, and “Electrical Boxes and Fittings”.

C. Install wiring in exposed ivory colored surface metal raceway where specifically noted as allowed on wall or ceilings.

D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals. Make soldered splices in electronic circuits in control cabinets.

3.4 INSTALLATION OF FIRE ALARM SYSTEMS:

A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."

B. Wiring: Wiring of fire alarm system is not specifically detailed on drawings. Refer to the manufacturer's shop drawings for detailed wiring and connection information.

1. Complete wiring in accordance with manufacturer's requirements. Provide Striped Color coded wiring and install per manufacturer's point-to-point wiring diagram. Determine exact number of wires for each fire area zone from number and types of devices installed. Connect each device with sufficient wiring to complete its intended operation.

2. Where there are a number of power requiring devices such as smoke detectors, fan relays, door holders and smoke damper operators installed in a circuit, group in numbers so power required does not exceed 80 percent of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed. Determine above with manufacturer's representative while equipment is being installed.
3. Where an existing system is present it shall remain in operation while the new system is being installed, tested, and accepted.
4. Mount audible and visual devices per Americans with disabilities Act (ADA) 1990 requirements.
5. SLC T-Tapping is acceptable, IDC and NAC T-Tapping is not allowed.

3.5 FIELD QUALITY CONTROL:

A. Connection and Supervision: Make connections to panel under manufacturer's supervision. Run wiring to main terminal cabinet located adjacent to main fire alarm panel. Complete connections from this cabinet to panel utilizing Manufacturer's technicians.

B. System Test and Approval: Submit shop drawings for function and operation only, pre-approved by authority having local jurisdiction.

1. Prior to final acceptance of system, manufacturer shall, in presence of Contractor and Owner's Representative, test each sensing or detection and alarm device including devices and equipment interlocks such as equipment shutdown and smoke dampers. Schedule test with Owner prior to testing.
2. The completed fire alarm system shall be fully tested in accordance with NFPA-72 by the contractor in the presence of the Owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor.
3. The contractor shall coordinate the testing of each fire alarm detector added or relocated under this project with the fire department and forward a completed checklist showing each detector operated properly and that proper indication of detector operation occurred at all control panels, annunciator panels, remote indicators, remote test switches, etc. In addition, proper interlocks, door release, etc. shall be documented with specific equipment affected listed by identifier.
4. Submit copy of test results in duplicate after signed by Owner's Representative to Architect/Engineer, Owner, and local Fire Protection Authority. Mount copy of inspection record in Lexan enclosed frame assembly on control panel.
5. Provide Record of Completion Documentation per NFPA-72.

3.6 MAINTENANCE CONTRACT:

A. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72 guidelines.

3.7 WARRANTY:

A. The Contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of one year from the date of acceptance as set forth in the general conditions.

3.8 OPERATING AND MAINTENANCE INSTRUCTIONS:

On completion of the work, the equipment manufacturer shall provide training for two maintenance personnel to a level equal to a "Factory-Certified Technician". The training shall be conducted at the vendor's local office or the Factory.

3.9 PAINTING AND PATCHING:

A. Contractor shall paint all exposed conduit to match adjacent surfaces. All surfaces or finishes damaged as a result of this work shall be properly patched, painted and/or repaired by trained craftsmen of the trade involved.

B. Blank plates shall be painted to match adjacent surfaces.

END OF SECTION 283111