
CONSTRUCTION DOCUMENTS
26 JULY 2024

HCH LEVEL 03 LABORATORY REMODEL PHASE I & II

PROJECT MANUAL

2000 CIRCLE OF HOPE DRIVE
SALT LAKE CITY, UTAH 84112

OWNER PROJECT NO: 70509
ARCHITECT PROJECT NO: 23054.01



TABLE OF CONTENTS

COVER
TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00010 PROJECT TITLE PAGE
000107 SEALS PAGE
001000 GENERAL CONDITIONS

DIVISION 01 - GENERAL REQUIREMENTS

011000 SUMMARY
012300 ALTERNATES
012500 SUBSTITUTION PROCEDURES
012600 CONTRACT MODIFICATION PROCEDURES
012900 PAYMENT PROCEDURES
013100 PROJECT MANAGEMENT AND COORDINATION
013200 CONSTRUCTION PROGRESS DOCUMENTATION
013300 SUBMITTAL PROCEDURES
014000 QUALITY REQUIREMENTS
015000 TEMPORARY FACILITIES AND CONTROLS
016000 PRODUCT REQUIREMENTS
017300 EXECUTION
017419 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
017700 CLOSEOUT PROCEDURES
017823 OPERATION AND MAINTENANCE DATA
017839 PROJECT RECORD DOCUMENTS
017900 DEMONSTRATION AND TRAINING

DIVISION 02 - EXISTING CONDITIONS

024119 SELECTIVE DEMOLITION

DIVISION 03

NOT USED

DIVISION 04

NOT USED

DIVISION 05

NOT USED

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

064116 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

HCI LEVEL 3 LAB REMODEL
PHASE I & II

AN 23054

078100 APPLIED FIREPROOFING
078413 PENETRATION FIRESTOPPING
078443 JOINT FIRESTOPPING
079200 JOINT SEALANTS
079219 ACOUSTICAL JOINT SEALANTS

DIVISION 08 - OPENINGS

081213 HOLLOW METAL FRAMES
081416 FLUSH WOOD DOORS
087100 DOOR HARDWARE

DIVISION 09 - FINISHES

095113 ACOUSTICAL PANEL CEILINGS
096510 RESILIENT FLOOR PREP
096513 RESILIENT BASE AND ACCESSORIES
096516 RESILIENT SHEET FLOORING
096519 RESILIENT TILE FLOORING
099110 PAINTING

DIVISION 10 - SPECIALTIES

102600 WALL AND DOOR PROTECTION

DIVISION 11 - EQUIPMENT

NOT USED

DIVISION 12 - FURNISHINGS

123553 LABORATORY CASEWORK

DIVISION 14 - CONVEYING EQUIPMENT

NOT USED

DIVISION 21 - FIRE SUPPRESSION

211000 WATER BASED FIRE SUPPRESSION SYSTEMS

DIVISION 22 - PLUMBING

220500 COMMON WORK RESULTS FOR PLUMBING
220518 ESCUTCHEONS FOR PLUMBING PIPING
220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553 IDENTIFICATION FOR PLUMBING PIPES AND EQUIPMENT
220719 PLUMBING PIPING INSULATION
221116 DOMESTIC WATER PIPING
221316 SANITARY WASTE AND VENT PIPING
224000 PLUMBING FIXTURES
224500 EMERGENCY PLUMBING FIXTURES
226113 COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES
226213 VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES
226313 GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

226710 PURE WATER PIPING

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

230100 MECHANICAL REQUIREMENTS
230150 TEMPORARY USE OF EQUIPMENT AND SYSTEMS
230500 COMMON WORK RESULTS FOR HVAC
230550 OPERATIONS AND MAINTENANCE OF HVAC SYSTEMS

DIVISION 26 – ELECTRICAL

26 0500 ELECTRICAL GENERAL PROVISIONS
26 0502 ELECTRICAL SUBMITTALS AND SPARE PARTS
26 0507 ELECTRICAL CONNECTIONS FOR EQUIPMENT
26 0519 CONDUCTORS AND CABLES (600V AND BELOW)
26 0526 GROUNDING
26 0529 SUPPORTING DEVICES
26 0532 CONDUIT RACEWAY
26 0533 ELECTRICAL BOXES AND FITTINGS
26 0536 RACEWAY SYSTEMS
26 0548 ELECTRICAL SEISMIC CONTROL
26 0553 ELECTRICAL IDENTIFICATION
26 0943 OCCUPANCY SENSORS
26 0943 LIGHTING CONTROL EQUIPMENT
26 2726 WIRING DEVICES
26 2815 OVERCURRENT PROTECTIVE DEVICES
26 4119 DEMOLITION
26 5100 INTERIOR AND EXTERIOR BUILDING LIGHTING

DIVISION 27 – COMMUNICATIONS

NOT USED

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 3111 TELEPHONE DATA SYSTEMS
28 3111 VOICE EVACUATION FIRE ALARM AND DETECTION SYSTEM

END OF TABLE OF CONTENTS

DOCUMENT 000101 - PROJECT TITLE PAGE

1.1 PROJECT MANUAL

- A. Huntsman Cancer Institute, HCI Level 03 Laboratory Remodel Phase 1
- B. 2000 Circle of Hope
- C. Salt Lake City, UT 84112
- D. Owner Project ID No. 70509.
- E. Owner's Project Manager: Vitoria Bini
- F. Architect Project No. 23054.01.
- G. Architectural Nexus, Inc.
- H. 2505 Parleys Way
- I. Salt Lake City, UT 84109
- J. Phone: 801.924.5000
- K. Fax: 801.924.5001
- L. Web Site: www.archnexus.com
- M. Issued: 07/01/14.
- N. Copyright Architectural Nexus, Inc. All rights reserved.

END OF DOCUMENT 000101

THIS PAGE IS INTENTIONALLY LEFT BLANK

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

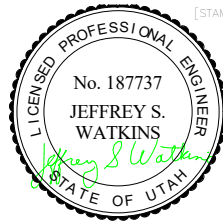
A. Architect:

1. Architectural Nexus
2. 2505 Parleys Way
3. Salt Lake City, UT 84109
4. Jessica Peterson
5. Responsible for Divisions 01-14



B. Mechanical Engineer:

1. Van Boerum & Frank Associates
2. 330 South 300 East
3. Salt Lake City, Utah 84111
4. Jeff Watkins
5. Responsible for Division 21, 22 & 23



C. Electrical Engineer:

1. BNA Consulting Engineers
2. 4225 Lake park Blvd.
3. West Valley City, UT 84120
4. Brian Hicks
5. Responsible for Division 26, 27, & 28.



END OF DOCUMENT 000107

SECTION 001000 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Conditions are provided by the University of Utah – Facilities Management Campus Design & Construction that are to be used for all portions of the project. The General Conditions may be found on the University's website.

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 by Owner.
 - 4. Work under separate contracts.
 - 5. Owner-furnished products.
 - 6. Access to site.
 - 7. Coordination with occupants.
 - 8. Work restrictions.
 - 9. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: Huntsman Cancer Institute.
 - 1. Project Location: Huntsman Cancer Hospital, Level 5 ICU REMODEL
University of Utah.
Salt Lake City, Utah 84112
- B. Owner: University of Utah. Owner's Representative: Deborah Alto at Campus Design and Construction.
- C. Huntsman Hospital's Project Manager: Ben Tanner
- D. Architect: Architectural Nexus
2505 East Parleys Way
Salt Lake City, Utah 84109
- E. Contractor/ Construction Manager: TBD

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Work consists of, but not limited to the following: Partial demolition of existing clinic space that is located on Level 2 of the existing Hospital. A portion of the existing clinic

departments will be relocating and in its place, new exam rooms, workrooms, fast-track lab, offices, patient waiting, procedure room, reception and support spaces will be added. Existing adjacent departments will remain in operation throughout the duration of construction and thus, will require multiple phases of construction.

B. Type of Contract

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

1.5 PHASED CONSTRUCTION

A. The Work may require multiple phasing and sequencing.

1. The Area of Work as indicated in the drawings shall be coordinated with the Owner's representatives and user groups. Anticipate some adjustments to the construction sequencing to allow current occupied spaces and operations to continue functioning during construction as permitted. The Contractor shall submit to the Owner prior to commencement of work a construction sequence/phase diagram for review and final approval. The plan shall correspond to the Contractor's proposed construction schedule.

B. ICRA:

1. The Contractor, while considering the phasing of the project shall follow the infection control construction guidelines as provided by the Owner and include in the construction documents. All temporary construction barriers shall be hard walls providing effective means of preventing airborne dust from dispersing into non-construction areas. All access openings through construction barriers shall be maintained and properly sealed.

1.6 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

1. The owner's facilities department will install small, wall mounted equipment in the locations indicated or desired. This will deal with items such as glove dispensers, gel sars, and other small medical items.

C. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.

1. Installation of Owner supplied and installed equipment.

1.7 OWNER-FURNISHED PRODUCTS

A. General: Owner has negotiated purchase contracts with suppliers of material and equipment to be incorporated into the Work (Medical Equipment). Owner will NOT assign these purchase

contracts to Contractor but the Contractor will be expected to coordinate with these firms to let them know when things are to a point when they can do their work.

1.8 ACCESS TO SITE

- A. General: 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.
- B. 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 loading areas, 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.
- C. 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.

1.9 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Notify the Owner not less than 72 hours in advance of activities that will affect Owner's operations.
 - 2. 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.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.10 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 6 p.m., Monday through Friday, except as otherwise indicated.
 - 1. Weekend Hours: Coordinate any weekend work hours with the Huntsman Hospital and the Universities project Manager.
 - 2. Early Morning Hours: Coordinate work before 7am with the University.

3. Hours for Utility Shutdowns: Provide 72 hour shutdown notice.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify University of Utah Project Manager and the Huntsman Cancer Hospital Manager not less than 3 days in advance of proposed utility interruptions.
 2. Obtain University's Project Manager and the Huntsman Cancer Hospital Manager's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify University Project Manager and the Huntsman Hospital Project manager not less than 3 days in advance of proposed disruptive operations.
 2. Obtain University's Project Manager and the Huntsman Cancer Hospital Project Manager written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted on campus.
- F. Controlled Substances: Use of tobacco products and other controlled substances within the existing building and on the Project site is not permitted.
- G. Employee Identification: Owner will provide identification tags for Contractor and sub contractor personnel working within the existing hospital building. Require personnel to utilize 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.12 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Add Alternate No. 1: Bid designated Laboratory Casework as Standard AWI Casework.

1. Base Bid: Provide and Install laboratory Grade casework at all areas in the project.
2. Add Alternate: Provide and Install Standard AWI grade casework and solid surface counter tops at designated locations. See plans for locations and finish schedule.

B. Add Alternate No. 2: Extent of Ceiling Tile Replacement.

1. Base Bid: Replace all Ceiling tile with-in the Scope of Work Area.
2. Add Alternate: Replace 50% of Existing Ceiling Tiles in the Scope of Work Area. Coordinate tiles to be replaced with Architect and Owner's Representative.

C. Add Alternate No. 3: Extent of Ceiling Tile Replacement.

1. Base Bid: Replace all Ceiling tile with-in the Scope of Work Area.
2. Add Alternate: Replace 20% of Existing Ceiling Tiles in the Scope of Work Area. Coordinate tiles to be replaced with Architect and Owner's Representative.

END OF SECTION 012300

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 Sections:
 - 1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 2. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use CSI Form 13.1A.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven working days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed

substitution within 10 working days of receipt of request, or seven working 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 qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 working 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. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.

- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. 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.

~~C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.~~

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

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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 Sections:
 - 1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Proposal Requests issued by Architect are 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: The Architect shall use the form attached in Division 00.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner Representative, Huntsman Hospitals Representative, Construction Manager and the Architect on the form in Division 00.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on the attached form in Division 00. 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

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment. **All pay requests are processed through the Unifier System.**
- B. Related Sections:
 - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 3. Division 01 Section "Submittal Procedures" for administrative requirements governing the preparation and submittal of the submittal 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. **Include the BSR codes required for Unifier processing of the pay request.**
1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 3. Sub schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide sub schedules showing values correlated with each phase of payment.
 4. Sub schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values correlated with each element.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. 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.

9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Progress payments shall be submitted to Architect by the **First** of the month. The period covered by each Application for Payment is one month, ending on the **last day of the month**.
 1. Submit draft copy of Application for Payment **seven** days prior to due date for review by Architect.
- D. Application for Payment Forms: Use Unifier accepted forms as the form for Applications for Payment.

- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. 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. Materials previously stored and included in previous Applications for Payment.
 - b. Work completed for this Application utilizing previously stored materials.
 - c. Additional materials stored with this Application.
 - d. Total materials remaining stored, including materials with this Application.
- G. 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.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- I. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
 - J. 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. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
 - K. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- L. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following: **Use forms acceptable to the University of Utah Unifier system.**
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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 project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Coordination drawings.
 - 4. Requests for Information (RFIs). **(Processed through Unifier System)**
 - 5. Project Web site. **Unifier System is being used by the University**
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
4. Division 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's commissioning authority.

1.3 DEFINITIONS

- A. RFI: Request from Owner, **Construction Manager**, Architect, or Contractor seeking information from each other during construction.

1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities **and activities of other contractors** to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
 9. Project closeout activities.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

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

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

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings as required to adequately represent the Work.
2. Plenum Space: Indicate sub framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inch diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.

- d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Architect determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Architect will so inform the Contractor, who shall make changes as directed and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as the original Drawings.
 2. File Preparation Format: DWG, Version, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 4. Architect will furnish Contractor one set of digital data files of the Drawings for use in preparing coordination digital data files after the sub contractors sign an electronic lien release form provided by the Architect upon request.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings.
 - b. Digital Data Software Program: The Drawings are available in Auto Desk format.

1.6 KEY PERSONNEL

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

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

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified. **All documents are processed through Unifier System.**

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

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

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

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

- C. RFI Forms: **Form in Unifier to process RFI's.**

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow **seven** working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day. RFI's received by the Architect that depend on information not received from the Contractor or sub contractor's will be returned and the RFI will be voided until all information is attached or received by the architect.

1. The following RFIs will be returned without action:

- a. Requests for approval of submittals.

- b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within **10** days of receipt of the RFI response.
- E. On receipt of Architect's action, immediately distribute the RFI response to affected parties. Review response and notify Architect within **seven** working days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log **weekly**. **RFI log is kept in Unifier and reviewed weekly at the construction meeting.**
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 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, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT WEB SITE

- A. **Use Owner's** Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. **The website is Skire Unifier system.** Project Web site shall include the following functions:
1. Project directory.
 2. Project correspondence.
 3. Meeting minutes.

4. Contract modifications forms and logs.
 5. RFI forms and logs.
 6. Task and issue management.
 7. Photo documentation.
 8. Schedule and calendar management.
 9. Submittals forms and logs.
 10. Payment application forms.
 11. Drawing and specification document hosting, viewing, and updating.
 12. Online document collaboration.
 13. Reminder and tracking functions.
 14. Archiving functions.
- B. Provide up to **seven** Project Web site user licenses for use of the Owner, **Owner's Commissioning Authority, Construction Manager**, Architect, and Architect's consultants. Provide **eight** hours of software training at Owner's office for Project Web site users.
- C. Upon completion of Project, provide **one** complete archive copy of Project Web site files to Owner and to Architect in a digital storage format acceptable to the Architect.
- D. Project Web site software package under their current published licensing agreements:
1. Universities website is Skire Unifier System.
- E. Contractor, subcontractors, and other parties granted access by the Contractor to project Web site shall execute a data licensing agreement in the form of an Agreement acceptable to the Owner and Architect.

1.9 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner's project manager, Hospitals Project Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Sustainable design requirements.
 - m. Preparation of record documents.
 - n. Use of the premises and existing building.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.
 - t. Procedures for disruptions and shutdowns.
 - u. Construction waste management and recycling.
 - v. Parking availability.
 - w. Office, work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner's Commissioning Authority, of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Construction Manager will schedule and conduct a Project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Construction Manager will conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties

involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
- 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Construction Manager will conduct Project coordination meetings as needed. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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. Start-up construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Daily construction reports.
 - 4. Material location reports.
 - 5. Field condition reports.
 - 6. Special reports.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 2. Division 01 Section "Quality Requirements" for submitting a 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.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. **One PDF copy over Skire Unifier system.**
- B. Start-up construction schedule.

1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Start-up Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Material Location Reports: Submit at weekly intervals.
- H. Field Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.
- J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

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

1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than **21** days, unless specifically allowed by Architect.

2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include not less than 30 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "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 Division 01 Section "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. Startup and placement into final use and operation.
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. Permanent space enclosure.
 - b. Completion of mechanical installation.
 - c. Completion of electrical installation.
 - d. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
- 1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.
- 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 RFIs.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
- G. Recovery Schedule: When periodic update indicates the Work is **14** or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Utilize Construction Manager's scheduling operating system software.

2.2 START-UP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit start-up horizontal bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first **90** days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Start-up Network Diagram: Submit diagram within 14 days of date established for the Notice of Award. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice of Award.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to correlate with Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the start-up network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing **and commissioning**.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of **5** percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts monthly before regularly scheduled progress meeting.

2.4 REPORTS

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

1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (refer to special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

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

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
 - 1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule 2 days 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.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner representatives, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals. **All submittals are done through the University system Skire Unifier System electronically.**
- B. Related Sections:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. 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.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Blue Beam used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule 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 modifications to submittals noted by the 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: Submit concurrently with start-up 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: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule 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 dates for installation.
- i. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will may be provided by Architect for Contractor's use in preparing submittals after the sub contractor or contractor requesting the electronic format signs an electronic release form provided by the architect and has made specific requests to exact files required.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in auto desk format.
- 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 different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow **15** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow **15** days for review of each resubmittal.
 - 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 requiring sequential review in first subparagraph below, or delete and identify submittals

in Sections where they are specified. Structural, HVAC, plumbing, and electrical components are examples of the Work that often require sequential review.

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 Architect before being returned to Contractor.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately **4 by 4 inches** on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.

- a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect **and Construction Manager**.
4. Include the following information on an inserted cover sheet:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Name of subcontractor.
 - h. Name of supplier.
 - i. Name of manufacturer.
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Other necessary identification.
- F. Options: Identify options requiring selection by the Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. PDF Copy only: PDF copy is required for final submittal, and unless Architect or Construction Manager observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect and Construction Manager will return submittals, without review, received from sources other than Contractor.
 1. Transmittal Form: Use Construction Managers form when sending and Architect will use the architect's form when returning submittals

2. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Indication of full or partial submittal.
 - j. Drawing number and detail references, as appropriate.
 - k. Transmittal **numbered consecutively**.
 - l. Submittal and transmittal distribution record.
 - m. Remarks.
 - n. Signature of transmitter.
 3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. 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 and Construction Manager's action stamp.
- K. Distribution: Furnish copy 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.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

PART 2 - PRODUCTS

- 2.1 SUBMITTAL PROCEDURES **(All submittals will be submitted as a PDF copy over the Skire Unifier website the University is using for the project)**
 - A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Action Submittals: **Submit one PDF copy** of each submittal, unless otherwise indicated. Architect, **through Construction Manager**, ~~will return two copies. Submit 4 copies if submittals are reviewed by the architect's consultants.~~
 - ~~2. Informational Submittals: Submit three paper copies of each submittal, unless otherwise indicated. Architect and Construction Manager will not return copies.~~
 - ~~3.2. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."~~
 - ~~4.3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.~~
 - a. Provide a notarized statement on original paper copy certificates and certifications where indicated.
 - ~~5.4. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."~~
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:

- a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. **One PDF copy** of Product Data, unless otherwise indicated. Architect, **through Construction Manager**, will return **an electronic PDF marked up copy**. **Submit One PDF copy** if reviewed by the architects consultants.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - ~~2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.~~
 - 3.2. Submit Shop Drawings in the following format:
 - a. Submit one PDF copy of each submittal. Architect and Construction Manager will retain marked up PDF copy. Submit One PDF copy if reviewed by Architect's consultants.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
3. 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.
4. 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 **two** full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return one submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two 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.

- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. Submit one PDF copy of product schedule or list, unless otherwise indicated. Architect, through Construction Manager, will return One marked copy.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. 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.
- J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- K. 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.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

- M. 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.
- N. 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.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. 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.
- R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. 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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- U. 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.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit 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.
- X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

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

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

- A. General: Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
 - 1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Divisions 02 through 49 Sections for specific test and inspection requirements.
 - 3. Division 01 Section "Commissioning" for verification of systems installed.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to

show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies. (Masonry, Precast and glazing system "This is part of Bid Package # 3).
 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- 1.4 CONFLICTING REQUIREMENTS
- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction. (Bid Package # 3 item).
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Contractor's Quality-Control Manager Qualifications: For supervisory personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
 - 1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
 - 2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. 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.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 Notice to Proceed, and 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 full-time 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: Include in quality-control plan 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.
 - 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, including tests and inspections indicated to be performed by the Commissioning Authority.
- 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 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, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.

- B. **Manufacturer's 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, and telephone number 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 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, and telephone number 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 whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. **Permits, Licenses, and Certificates:** For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

- A. **General:** Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect and Construction Manager.
 2. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's and Construction Manager's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove exterior mockup and keep the finishes in the patient room mockups as the permanent finishes.
- K. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished in accordance with requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Provide room mockups of the following rooms:
1. Finish a typical inpatient room, ICU room and BMT room as soon as possible in its permanent location to review with the owner and leave as the finish product.

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 inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
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. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. 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.
- E. 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.
- F. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of the Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses. .
1. Distribution: Distribute schedule to Owner, Architect, Construction Manager, 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 testing agency, special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency, special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Construction Manager, 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, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. 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 modifications as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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 Sections:
 - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, 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. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
 - 1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- B. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of the work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air filtration system discharge.
 - 4. Other dust-control measures.
 - 5. Waste management plan.

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 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. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils minimum thickness, with flame-spread rating of 15 or less per ASTM E 84.
- B. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- 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. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, 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 16 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
 - 3. Drinking water.

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.
- C. 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 Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures".
- C. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 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. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. 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.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 1. Toilets: Use of Owner's existing toilet facilities will not be permitted.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas. (When constructing in areas of the hospital all construction must follow the infection control measures required by the hospital).
 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
 - 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.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Install electric power service from the existing hospital service, by Okland construction..
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install telephone line(s) for each field office.
1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.

4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."
- Q. 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.
- R. Parking: Use designated areas of Owner's existing parking areas worked out with the University for construction personnel.
- S. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- T. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.
- U. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- V. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- W. 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.

- X. Temporary Elevator Use: Use of existing elevators is permitted.
- Y. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- Z. 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.
- AA. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 01 Section "Summary."
- B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- E. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant 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.
 8. Comply with all infection control measures required by the hospital.
- F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace or clean stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. 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 Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Sections:
 - 1. Division 01 Section "Substitution Procedures" for requests for substitutions.
 - 2. Division 01 Section "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 Division 01 Section "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 Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

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

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft 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. Store 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. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, 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 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. Non restricted 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. Non restricted 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 Division 01 Section "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

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. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

- B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

3. Division 02 Section "Selective Structure Demolition" for demolition and removal of selected portions of the building.
4. Division 07 Section "Penetration Fire stopping" 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 INFORMATIONAL SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate how long services and systems will be disrupted.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. 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 the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. 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. Conveying systems.
 - i. Electrical wiring systems.
 - j. Operating systems of special construction.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.

- d. Equipment supports.
 - e. Piping, ductwork, vessels, and equipment.
 - f. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.6 WARRANTY

- A. 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- 1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."
- 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 the 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 site work, 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to

other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. 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 and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 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.
- 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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. 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.
- G. 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.
- H. 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.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 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. Temporary Support: Provide temporary support of work to be cut.
- C. 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.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."
- E. 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.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- G. 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 weather tight condition.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.7 OWNER-INSTALLED PRODUCTS
- A. Site Access: Provide access to Project site for Owner's construction personnel.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 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. Utilize containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- 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 Division 01 Section "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to 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.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and 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. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1. Construction Waste:

- a. Site-clearing waste.
- b. Masonry and CMU.
- c. Lumber.
- d. Wood sheet materials.
- e. Wood trim.
- f. Metals.
- g. Roofing.
- h. Insulation.
- i. Carpet and pad.
- j. Gypsum board.
- k. Piping.
- l. Electrical conduit.
- m. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.

- 4) Plastic sheet and film.
- 5) Polystyrene packaging.
- 6) Wood crates.
- 7) Plastic pails

1.4 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 2. Review requirements for documenting quantities of each type of waste and its disposition.
 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 5. Review waste management requirements for each trade

PART 2 - EXECUTION

2.1 PLAN IMPLEMENTATION

- A. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

2.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

- B. Salvaged Items for Sale Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

2.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

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 Sections:

- ~~1. Division 01 Section "Photographic Documentation" for submitting final completion construction photographic documentation.~~
- 2.1. Division 01 Section "Execution" for progress cleaning of Project site.
- 3.2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- 4.3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- 5.4. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- 6.5. Division 01 Section "Commissioning" for training and verification issues of systems.
- 7.6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- 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 the Project Manual. **(Also provide a copy of the warranties on an electronic disk as scanned PDF files).**

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- D. 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 meet Green Seal 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 portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls." And Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION 017700

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: **(All final submittals will be in PDF format and submitted on disks)**
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
 - 3. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

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. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Agent will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Agent will return copy with comments.
 - 1. Correct or modify each manual to comply with Architect's and Commissioning Agent's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Agent's comments and prior to commencing demonstration and training.
 - 2. Final Operation and Maintenance manuals will only be submitted as a PDF format as described above.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Agent.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon 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 upon opening file.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.

2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

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

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

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

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

2.4 PRODUCT MAINTENANCE MANUALS

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

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

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

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

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

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.

3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to operation, and maintenance manuals.
1. **All manuals will be created as PDF files and placed onto disks for submittal. All disks will be indexed for access to sections in the manuals.**
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
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.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

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 Sections:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Final Submittal: Submit one paper copy set of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded. Record and post all RFI's, ASI,s, PR's, CCD's on the drawings. Include any dimensional changes and record the locations of all underground utility lines on the plans.
- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated PDF electronic files of each submittal.
1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
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 archive 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 below first floor.
 - 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. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets 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.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy.

2.3 RECORD PRODUCT DATA

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

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

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

B. Format: Submit miscellaneous record submittals as paper copy.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
- B. Related Sections:
 - 1. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

- B. Qualification Data: For facilitator and instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "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.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- 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 has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.

- c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- F. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 MATERIALS OWNERSHIP

- A.** Unless otherwise indicated, demolition waste becomes property of Contractor.
- B.** Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

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

1.4 INFORMATIONAL SUBMITTALS

- A.** Engineering Survey: Submit engineering survey of condition of building.
- B.** Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C.** Schedule of selective demolition activities with starting and ending dates for each activity.
- D.** Predemolition photographs or video.
- E.** Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove items of interest or value to Owner.
- 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.
- G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- C. Engage a specialist to perform concrete scanning using GPR (Ground Penetrating Radar) technology before cutting, drilling or coring of existing structure to detect and avoid damage to embed electrical/communication conduits, pipework or structural reinforcement.
- D. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

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

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Coordinate and arrange with Owner to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain fire watch during and for at least one and half-hours after flame-cutting operations.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 6. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition[**and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

3.6 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. 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. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate-faced architectural cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets that are not concealed within other construction.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: For plastic-laminate-faced architectural cabinets.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show large-scale details.
 - 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 plastic-laminate architectural cabinets.
 - 5. Comply to AWI Standards and Procedure for shop drawings.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or fabricator's standard size.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Comply with AWI Quality Standards.
- B. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.
- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- D. 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.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by as indicated in the Finish Schedule on Drawings.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges:
 - a. Doors and Drawers: PVC edge banding, 0.12 inch thick (3 mm), matching laminate in color, pattern, and finish.
 - b. Side Panels and Boxes: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish
 - 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels unless indicated otherwise.
- G. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - c. 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. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. 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.
- K. 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 in the Finish Schedule on the Drawings.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. Thermoset Decorative Panels: Particleboard or MDF 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.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials 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.
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, 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. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
- C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
 - 1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
 - 2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity,

250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.

- D. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in "Door Hardware
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted.
 - a. Type: Full extension.
 - b. Material: 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 1HD-100.
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
 - 6. For computer keyboard shelves, provide Grade 1.
 - 7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.
- H. Slides for Sliding Glass Doors: BHMA A156.9, B07063; aluminum.
- I. Standard Locks:
 - 1. Cabinets: National Keyway #100DR.
 - 2. Drawers: National Keyway #200DW.
 - 3. Drawers at the End of a Bank: National Keyway #300SD.
 - 4. Locations: As indicated as "Lockable" on Drawings.
- J. Door and Drawer Silencers: BHMA A156.16, L03011.

- K. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.
- L. 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.
- M. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Color: Black.
- N. Provide for wire passage at all countertops requiring cable passage (e.g. workstations, printers, desktop computers, etc.) Coordinate final locations of grommet holes with tenant and architect. Provide at each workstation. 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.
- O. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- P. Wrist Rest: W-K Wrist Rest #18072-1, Keyboard platform cushion 0.75 inches.
- Q. File Bar and Holder Rail (File Drawers): Blum File Hanger System, ZRM.5500.US Metafile or equal.
- R. Elbow Catch: BHMA A156.9 B33023, Ives Elbow Catch or equal.
- S. Wardrobe Coat Hooks:
 - 1. Basis-of-Design Product: Bobrick B-2116.
 - 2. Mounting: Wall mounted, concealed fasteners.
 - 3. Capacity: Single prong.
- T. Wardrobe Clothes Rods:
 - 1. Bobrick B-6107 Heavy Duty Rod
 - 2. Size: 1" dia. by required length.
 - 3. Finish: Stainless steel.
- U. Trash Liner Rings: Pride Industrial, Stainless Steel Trash Liners, TR8x2.SS, 8" dia. x 2" deep x 3/8" lip.

2.5 EXPOSED ADJUSTABLE SHELVING

- A. Exposed Adjustable Shelving: Made from the following materials:
 - 1. **1-inch** thick, melamine-faced particleboard with radiused and filled applied PVC front edge. Do not use particleboard or MDF that contains urea formaldehyde.
 - 2. Shelf Brackets & Standards: KV standards and brackets.
 - 3. Color: As indicated in Finish Schedule on Drawings.

2.6 MISCELLANEOUS MATERIALS

- A. Concealed countertop steel support brackets
 - 1. Manufacturer:
 - a. A&M Hardware
 - 2. Size: 2.0" version: 9", 12", 18", 24" and 30" support arm lengths
 - 3. Upper extension (EC) and without (C)
 - 4. Mounting hardware.
 - 5. Color: White, powder coat
 - 6. Locations: As indicated on Drawings.
- B. Exposed countertop steel support brackets
 - 1. Manufacturer:
 - a. Doug Mockett, SWS-4
 - b. US Futaba, USF-72531
 - c. Or equal
 - 2. Sizes: 24" and 30" support arm lengths
 - 3. Color: Selected from full range of standard colors.
- C. Aluminum Trim:
 - 1. Extruded Bars and Shapes: ASTM B 221, Alloy 6063-T5/T52.
 - 2. Shape & Size: As indicated on drawings.
 - 3. Finish: Clear anodic, brushed finish.
- D. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber and Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- E. 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.
- F. **Metal:**
 - 1. **Steel tube support columns/posts and sheet metal associated with or concealed in architectural millwork shall be provided under this section. Comply with Section 055000 Metal Fabrication for requirements and installation**

2.7 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 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.
1. Seal all edges by applying edge banding to all raw, exposed edges. (No raw, exposed panel edges allowed).
- D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."
1. For glass in frames, secure glass with removable stops.
 2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes SFRMs applied to surfaces for NEW STRUCTURES, and PATCH and REPAIR of existing as required for the work that are concealed from view behind other construction when the Work is completed.
- B. Applied fireproofing materials shall match the existing and be compatible to the existing for proper adhesion to and comparable coverage to the existing fireproofing materials

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show extent of sprayed fire-resistive material for each construction and fire-resistance rating, applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction, and minimum thicknesses.
- C. Product certificates.
- D. Compatibility and adhesion test reports.
- E. Research/evaluation reports.
- F. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer approved by SFRM manufacturer to install manufacturer's products. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
 - 1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive

- materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.
- C. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.
- D. Fire-Test-Response Characteristics: Where indicated, provide products identical to those tested for fire resistance per ASTM E 119 by a testing agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 2. Identify products with appropriate markings of applicable testing and inspecting agency.
- E. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
- F. Preinstallation Conference: Conduct conference at Project site.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is 40 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.
- C. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:
1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
 3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.

4. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
5. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
6. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
7. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SFRM

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Medium Density Sprayed-Fiber Fire-Resistive Material:
 - a. Isolatak International Corp.; Cafco Blaze-Shield HP.
 - b. Grace, W. R. & Co. - Conn.; Grace Construction Products; Monokote Z106.
- B. Material Composition: Manufacturer's standard product, as follows:

1. Concealed Sprayed-Fiber Fire-Resistive Material: Factory-mixed, dry formulation of inorganic binders, mineral fibers, fillers, and additives conveyed in a dry state by pneumatic equipment and mixed with water at spray nozzle to form a damp, as-applied product.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: 22 lb/cu. ft. for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWC Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:
 - a. Where the referenced fire-resistance design lists a thickness of 1 inch or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch.
 - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of SFRM is the greater of 0.375 inch or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft.
 3. Bond Strength: 434 lbf/sq. ft. minimum per ASTM E 736 based on laboratory testing of 0.75-inch minimum thickness of SFRM.
 4. Compressive Strength: 10 lbf/sq. in. minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch and minimum dry density shall be as specified but not less than 15 lb/cu. ft..
 5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
 6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
 7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
 8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch, maximum dry density is 22 lb/cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
 9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 0.
 10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
 - 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 - 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.
- D. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
 - 1. Product: Subject to compliance with requirements, provide "Cafco Bond-Seal" by Isolatek International Corp.
- E. Topcoat: Type recommended in writing by manufacturer of each SFRM.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected.

- B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- C. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- D. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.
- E. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.
- F. Install, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of to substrate.
- G. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.
- H. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- I. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.
- J. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.
- K. Apply water overspray to concealed sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating.
- L. Cure concealed SFRM according to product manufacturer's written recommendations.
- M. Apply sealer to concealed SFRM.
- N. Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

- O. Repair or replace work that has not successfully protected steel.

3.2 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
 - 1. SFRM.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- C. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
- D. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
- E. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

END OF SECTION 078100

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.
- 2. Penetrations in horizontal assemblies.
- 3. Penetrations in smoke barriers.
- 4. Fire rated wall assembly identification.

- 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 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

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

- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

- 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 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."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, 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.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Construction Solutions.
 - d. Grabber Construction Products.
 - e. Hilti, Inc.
 - f. Specified Technologies, Inc.
 - g. Tremco; Sealant/Weatherproofing Division.
 - h. USG Corporation.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. 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 system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system 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: Before installing penetration firestopping systems, clean out openings immediately 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 materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. 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.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- 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.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 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. Wall Identification: Permanently label fire rated wall assemblies as indicated on drawings with its corresponding text below using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - “1-HOUR FIRE BARRIER”
 - “2-HOUR FIRE BARRIER”
 - “3-HOUR FIRE WALL”
 - “1-HOUR SMOKE BARRIER”
- 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. 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 according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems 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 system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are 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 material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

- A. **See G Sheets where UL numbers are shown for the various types of penetrations shown.**
- B. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- C. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."
- D. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

- A. Firestop Systems with No Penetrating Items:
 - 1. Available UL-Classified Systems: C-AJ- 0001-0999; F-A- 0001-0999; W-L-0001-0999.
- B. Firestop Systems for Metallic Pipes, Conduit, or Tubing:
 - 1. Available UL-Classified Systems: C-AJ- 1001-1999; F-A- 1001 – 1999; W-L – 1001-1999
- C. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:
 - 1. Available UL-Classified Systems: C-AJ- 2001-2999; F-A- 2001-2999; W-L- 2001-2999.
- D. Firestop Systems for Electrical Cables:
 - 1. Available UL-Classified Systems: C-AJ- 3001-3999; F-A- 3001-3999; W-L-3001-3999.
- E. Firestop Systems for Cable Trays:
 - 1. Available UL-Classified Systems: C-AJ- 4001-4999; F-A- 4001-4999; W-L-4001-4999.
- F. Firestop Systems for Insulated Pipes:
 - 1. Available UL-Classified Systems: C-AJ- 5001-5999; F-A- 5001-5999; W-L- 5001-5999.
- G. Firestop Systems for Miscellaneous Electrical Penetrants:
 - 1. Available UL-Classified Systems: C-AJ- 6001-6999; F-A- 6001-6999; W-L- 6001-6999.
- H. Firestop Systems for Miscellaneous Mechanical Penetrants:
 - 1. Available UL-Classified Systems: C-AJ-7001-7999; W-L-7001-7999.
- I. Firestop Systems for Groupings of Penetrants:
 - 1. Available UL-Classified Systems: C-AJ- 8001-8999; F-A- 8001-8999; W-L-8001-8999.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 079500 "Expansion Control" for fire-resistive architectural joint systems.
3. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each type of product.
- B. Product Schedule:** For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A/D Fire Protection Systems Inc.
 - b. CEMCO.
 - c. Fire Trak Corp.
 - d. Grace Construction Products.
 - e. Hilti, Inc.
 - f. Johns Manville.
 - g. Nelson Firestop Products.
 - h. NUCO Inc.
 - i. Passive Fire Protection Partners.
 - j. RectorSeal Corporation.
 - k. Specified Technologies Inc.
 - l. 3M Fire Protection Products.
 - m. Tremco, Inc.; Tremco Fire Protection Systems Group.

- n. USG Corporation.
- 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A/D Fire Protection Systems Inc.
 - b. CEMCO.
 - c. Fire Trak Corp.
 - d. Grace Construction Products.
 - e. Hilti, Inc.
 - f. Johns Manville.
 - g. Nelson Firestop Products.
 - h. NUCO Inc.
 - i. Passive Fire Protection Partners.
 - j. RectorSeal Corporation.
 - k. Specified Technologies Inc.
 - l. 3M Fire Protection Products.
 - m. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - n. USG Corporation.
 - 2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems 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 elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible

to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN.

- B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under product category Expansion/Seismic Joints or Firestop Systems.

- C. Floor-to-Floor, Joint Firestopping Systems:
 - 1. UL-Classified Systems: FF-D-.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class III.
 - 5. L-Rating at Ambient: As required.
 - 6. L-Rating at 400 Deg F: As required.
 - 7. W-Rating: No leakage of water at completion of water leakage testing.

- D. Wall-to-Wall, Joint Firestopping Systems:
 - 1. UL-Classified Systems: WW-D-.
 - 2. Assembly Ratings: 1 hour or 2 hours, as indicated.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class III.
 - 5. L-Rating at Ambient As required.
 - 6. L-Rating at 400 Deg F: As required.

- E. Floor-to-Wall, Joint Firestopping Systems:
 - 1. UL-Classified Systems: FW-D-.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: As indicated.

4. Movement Capabilities: Class III.
5. L-Rating at Ambient: As required.
6. L-Rating at 400 Deg F: As required.

F. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:

1. UL-Classified Systems: HW-D-.
2. Assembly Ratings: 1 hour or 2 hours, as indicated.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class I.
5. L-Rating at Ambient: As required.
6. L-Rating at 400 Deg F: As required.

G. Perimeter Joint Firestopping Systems:

1. UL-Classified Perimeter Fire-Containment Systems: CW-D-.
2. Integrity Rating: 2 hours.
3. Linear Opening Width: As indicated, maximum.
4. Movement Capabilities: Class II and Class III.
5. F-Rating: 2 hours.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Mildew-resistant joint sealants.
 - 5. Latex joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction laboratory test reports.
- C. Preconstruction field-adhesion-test reports.

- D. Field-adhesion-test reports.
- E. Sample warranties.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with stone substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 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. **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. Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Tremco; Spectrem 1 (Basic).
 - d. GE Silicones; SilPruf SCS2000.
 - e. Pecora Corporation; 864.

- f. Pecora Corporation; 890.
- g. Polymeric Systems Inc.; PSI-641.
- h. Sonneborn, Division of ChemRex Inc.; Omniseal.
- i. Dow Corning Corporation; 791.
- j. Dow Corning Corporation; 795.
- k. GE Silicones; SilPruf NB SCS9000.
- l. GE Silicones; UltraPruf II SCS2900.
- m. Pecora Corporation; 865.
- n. Pecora Corporation; 895.
- o. Pecora Corporation; 898.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.
 - 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. Sika Corporation, Inc.; Sikaflex - 1a.
 - b. Sonneborn, Division of ChemRex Inc.; Ultra.
 - c. Sonneborn, Division of ChemRex Inc.; NP 1.
 - d. Tremco; Vulkem 116.

2.4 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. **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. [Dow Corning Corporation.](#)
 - b. [GE Construction Sealants; Momentive Performance Materials Inc.](#)
 - c. [May National Associates, Inc.; a subsidiary of Sika Corporation.](#)

- C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Bostik Findley; Chem-Calk 600.
 - b. Pecora Corporation; AC-20+.
 - c. Schnee-Morehead, Inc.; SM 8200.
 - d. Sonneborn, Division of ChemRex Inc.; Sonolac.
 - e. Tremco; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Vertical joints on exposed surfaces of walls and partitions.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P or NS, 25, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:

- a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples: For each kind and color of acoustical joint sealant required.
- 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.4 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.

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
 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. [Accumetric LLC.](#)
 - b. [Franklin International.](#)
 - c. [GE Construction Sealants; Momentive Performance Materials Inc.](#)
 - d. [Grabber Construction Products.](#)
 - e. [Hilti, Inc.](#)
 - f. [OSI Sealants; Henkel Corporation.](#)
 - g. [Pecora Corporation.](#)
 - h. [Serious Energy Inc.](#)
 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- B. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- C. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

- D. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing 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.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 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.

END OF SECTION 079219

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:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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.
- C. Product Schedule: For hollow-metal doors and frames, 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

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. Pioneer Industries.
 4. Republic Doors and Frames.
 5. Rocky Mountain Metals, Inc.
 6. Security Metal Products; a brand of ASSA ABLOY.
 7. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F** above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.10 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) when tested according to ASTM C 518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. .

1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Uncoated steel sheet, minimum thickness of **0.042 inch**.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard.

- f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.
2. Frames:
- a. Materials: Uncoated steel sheet, minimum thickness of **0.053 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Face welded.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A..

1. Doors:
- a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with minimum **A40** coating.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Polyurethane or Polyisocyanurate with vertical steel stiffeners.
 - h. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
2. Frames:
- a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with minimum **A40** coating.
 - b. Construction: Full profile welded.

2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness **matching adjacent door frame construction**.
- B. Construction: Full profile welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each **24 inches** of frame height above **7 feet**.
3. Postinstalled Expansion Anchor: Minimum **3/8-inch-** diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than **2-inch** height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: 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.

2.7 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. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. 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.

F. 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.

G. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite 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 welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
 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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation 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.

2.9 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Hollow-Metal Frames: Comply with SDI A250.11.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 2. Fire-Rated Openings: Install frames according to NFPA 80.
 3. Floor Anchors: 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.
 4. Solidly pack mineral-fiber insulation inside interior frames.
 5. Fill inside of exterior frames with closed-cell spray polyurethane foam.
 6. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 7. 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.
 8. Installation Tolerances: Adjust hollow-metal frames 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.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, section 5.2
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.4 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Five-ply flush wood veneer-faced doors 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 018113.14 "Sustainable Design Requirements" for requirements and procedures for compliance with certain prerequisites and credits needed for the project to obtain LEED certification.

1.2 ACTION SUBMITTALS**A. Product Data:** For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction (at areas indicated as wood frames).
7. Factory-machining criteria.
8. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Clearances and undercuts.
6. Requirements for veneer matching.

C. Samples: For factory-finished doors.**D. LEED Submittals:** Comply with requirements of Section 018113.14 Sustainable Design Requirements – LEED V4 BD+C.**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 WARRANTY

A. 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 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F** above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
- 2.2 FLUSH WOOD DOORS, GENERAL
- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
1. Provide labels from WI certification program indicating that doors comply with requirements of grades specified.
- 2.3 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

Interior Doors:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Eggers Industries.
 - b. Masonite Architectural.
 - c. Oshkosh Door Company.
 - d. VT Industries Inc.
2. Performance Grade:
 - a. ANSI/WDMA I.S. 1A Heavy Duty unless otherwise indicated below.
 - b. ANSI/WDMA I.S. 1A **Extra Heavy Duty: toilets, janitor's closets, exits, and patient rooms.**
3. ANSI/WDMA I.S. 1AGrade: Premium.
4. Faces: Single-ply wood veneer, Grade A, not less than **1/50 inch** thick.
 - a. Species and Cut:
 - 1) Select White Maple, plain sliced, to match Architect's sample.
 - 2) Cherry, quarter sliced, to match architect's sample.
 - b. Match between Veneer Leaves: Slip match.
 - c. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - d. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - e. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by **10 feet** or more.

- f. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - g. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."
5. Exposed Vertical and Top Edges: Same species as faces - Architectural Woodwork Standards edge Type A.
- a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors: 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.
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: **550 lbf** in accordance with WDMA T.M. 10.
6. Core for Non-Fire-Rated Doors:
- a. ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard made with binder containing no urea-formaldehyde.
 - 1) 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.
 - c) **5-inch** midrail blocking, in doors indicated to have exit devices.
 - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Face: **550 lbf**.
 - 2) Screw Withdrawal, Edge: **550 lbf**.
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:

- 1) 5-inch top-rail blocking.
- 2) 5-inch bottom-rail blocking, in doors indicated to have protection plates.
- 3) 5-inch midrail blocking, in doors indicated to have armor plates.
- 4) 5-inch midrail blocking, in doors indicated to have exit devices.

8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

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: As selected by Architect from manufacturer's full range of custom profiles.
 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 on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.

2.6 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.

3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
1. Premium.
 2. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
 3. Staining: Match Architect's sample.
 4. Effect: Open-grain finish.
 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

Install fire-rated doors in accordance with NFPA 80.

2. Install smoke- and draft-control doors in accordance with NFPA 105.
- C. Job-Fitted Doors:
1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 2. Machine doors for hardware.
 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 4. Clearances:
 - a. Provide **1/8 inch** at heads, jambs, and between pairs of doors.
 - b. Provide **1/8 inch** from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide **1/4 inch** from bottom of door to top of threshold unless otherwise indicated.
 - d. Comply with NFPA 80 for fire-rated doors.
 5. Bevel non-fire-rated doors **1/8 inch in 2 inches** at lock and hinge edges.
 6. Bevel fire-rated doors **1/8 inch in 2 inches** at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.

- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 087100 - DOOR HARDWARE**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Fire-rated swinging doors.
 - c. Other doors to the extent indicated.
- 2. Cylinders for doors specified in other Sections.
- 3. Electrified door hardware.

- B. Related Sections include the following:

- 1. Division 08 Section "Hollow Metal Doors and Frames"
- 2. Division 08 Section "Aluminum-Framed Entrances and Storefronts"
- 3. Division 08 Section "Flush Wood Doors"
- 4. Division 08 Section "Overhead Coiling Doors"
- 5. Division 08 Section "Sectional Door" for door hardware.
- 6. Division 08 Section "Sliding Doors"
- 7. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
- 8. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
- 9. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
- 10. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

- 1. Thresholds, weather stripping, and cylinders for locks specified in other Sections.

1.3 REFERENCED STANDARDS

- A. Provide hardware in accordance with the following standards in addition to those specified in Division 01 Section "References".

- 1. American National Standards Institute (ANSI), A117.1: Accessible and Usable Buildings and Facilities, edition as adopted by local Authority Having Jurisdiction (AHJ).

2. Builders Hardware Manufacturer's Association (BHMA)
 - a. ANSI/BHMA A156.2: Bored and Preassembled Locks and Latches, 2011 edition
 - b. ANSI/BHMA A156.13: Mortise Locks and Latches, 2012 edition
 - c. ANSI/BHMA A156.3: Exit Devices, 2008 edition
 - d. ANSI/BHMA A156.4: Door Controls - Closers, 2008 edition
 - e. ANSI/BHMA A156.2: Bored and Preassembled Locks and Latches, 2011 edition
 - f. ANSI/BHMA A156.15: Release Devices – Closer Holder, Electromagnetic, and Electromechanical, 2011 edition
 - g. ANSI/BHMA A156.18: Materials and Finishes, 2006 edition
 - h. ANSI/BHMA A156.19: Power Assist and Low Energy Power Operated Doors, 2007 edition
3. Door and Hardware Institute (DHI)
 - a. Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames, 2004 edition
 - b. Installation Guide for Doors and Hardware, 1994 edition
 - c. Sequence and Format for the Hardware Schedule, 2001 edition
4. National Fire Protection Association (NFPA)
 - a. NFPA 70: National Electrical Code, edition as adopted by local AHJ.
 - b. NFPA 80: Standard for Fire Doors and Other Opening Protectives, edition as adopted by local AHJ.
 - c. NFPA 252: Standard Methods of Fire Tests of Door Assemblies, edition as adopted by local AHJ.

1.4 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
 1. Wiring Diagrams: Power, signal, and control wiring. Include the following:
 - a. System schematic.
 - b. Point-to-point wiring diagram.
 - c. Riser diagram.
 - d. Elevation of each door.
 2. Detail interface between electrified door hardware and fire alarm, access control, security, building control system.
 3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.
 1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- D. Qualification Data: For Installer

- E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.
- F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- G. Warranty: Special warranty specified in this Section.
- H. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - 2. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, and material of each door and frame.
 - b. Type, style, function, size, quantity, and finish of each door hardware item.
 - c. Complete designations of every item required for each door or opening including name and manufacturer.
 - d. Fastenings and other pertinent information.
 - e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - f. Explanation of abbreviations, symbols, and codes contained in schedule.
 - g. Mounting locations for door hardware.
 - h. Door and frame sizes and materials.
 - i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - 1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
 - j. List of related door devices specified in other Sections for each door and frame.
 - 3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 2. Installer shall have warehousing facilities in Project's vicinity.
 - 3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 and UBC Standard 7-2.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

1.7 COORDINATION

- A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Coordinate with aluminum entrance door supplier for door hardware installation.
- D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:
 - a. Continuous Hinges: Lifetime of Building
 - b. Grade 1 Cylindrical Locks: Ten (10) years from date of Substantial Completion.
 - c. Grade 1 Mortise Locks: Seven (7) years from date of Substantial Completion.
 - d. Exit Devices: Three (3) years from date of Substantial Completion.
 - e. Manual Closers: Thirty (30) years from date of Substantial Completion.
 - f. Automatic Operators: Two (2) years from date of Substantial Completion.
 - g. Electrified Hardware Items: One (1) year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

1.10 EXTRA MATERIALS

- A. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Door Hardware:
1. 2 each Von Duprin 98-L x 626 Exit Devices
 2. 2 each Schlage L9080R 12A x 626 Locksets
 3. 2 each LCN 4040XP EDA 689 Closers

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hinges: Ives, Hager, Stanley, McKinney, Bommer

2.	Continuous Hinges:	Ives, Stanley, Hager, Select,
3.	Operating Door Trim:	Ives, Rockwood, Hager, Trimco
4.	Decorative Door Pulls:	Ives, Rockwood, Hager, Burns
5.	Electric Strikes:	Von Duprin, HES, Foldger Adams
6.	Locks and Latches:	Schlage, Owner's Standard
7.	Electro-Magnetic Locks:	Schlage Electronics, Securitron, SDC
8.	Cylinders and Cores:	Furnished and keyed by Owner
9.	Exit Devices:	Von Duprin, Owner's Standard
10.	Mechanical Door Closers:	LCN, Owner's Standard
11.	Closer Release Devices:	LCN, Rixson, ABH, Sargent
12.	Automatic Operators:	Stanley, Owner's Standard
13.	Accessories and Trim:	Ives, Rockwood, Hager, Trimco
14.	Overhead Stops and Holders:	Glynn Johnson, Rixson, ABH, Sargent
15.	Saddle and Panic Thresholds:	Zero, National Guard, Pemko
16.	Weather Strip and Gasket:	Zero, National Guard, Pemko
17.	Miscellaneous Hardware:	Ives, Rockwood, Hager, Trimco
18.	Emergency Access Key Box:	Knox, Inc

- B. Substitutions submitted in compliance with Division 01 Section "Substitutions" requirements will be reviewed for conformance to basis of design.

2.2 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. **Manufacturer's Product Designations:** The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.

2.3 MATERIALS AND FABRICATION

A. General

1. **Manufacturer's Name Plate:** Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
2. **Base Metals:** Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
3. Provide hardware manufactured to conform to published templates generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

B. Fasteners

1. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish stainless steel (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish

of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

2. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Use through bolts only as indicated in this section unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES

A. Acceptable Products:

- | | | | |
|----|-----------|--------|--------|
| 1. | Ives: | 3CB1 | 3CB1HW |
| 2. | Hager: | AB700 | AB750 |
| 3. | Stanley: | CB1900 | CB1901 |
| 4. | McKinney: | TB714 | TB786 |
| 5. | Bommer: | LB8000 | LB8004 |

B. Requirements:

1. Quantity: Provide the following, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
2. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
3. Hinge Weight: As indicated in hardware sets.
4. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - a. Exterior Hinges: Stainless steel with stainless-steel pin.
 - b. Interior Hinges: Steel with steel pin.
 - c. Hinges for Fire-Rated Assemblies: Steel with steel pin.
5. Hinge Options: Where indicated in door hardware sets or on Drawings:
 - a. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
 - b. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging doors.
 - c. Corners: Square.
6. Fasteners: Comply with the following:
 - a. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - b. Wood Screws: For wood doors and frames.
 - c. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

2.5 CONTINUOUS HINGES

A. Acceptable Products:

- | | | | | |
|----|----------|-------|-------|-----|
| 1. | Ives: | 112HD | 224HD | 700 |
| 2. | Stanley: | 661HD | 662HD | 651 |

3.	Hager:	780-112HD	780-224HD	790-900
4.	Select:	SL11HD	SL24HD	SL300

B. Requirements:

1. Geared Continuous Hinges: Shall utilize a single gear section for the door leaf and a separate gear section for the frame side of the door. Provide full mortise or surface applied hinge as scheduled in each set. Geared hinges are to be UL 10C tested and approved for 90 minutes.
2. Pin and Barrel Continuous Hinges: Shall be a twin self-lubricated nylon bearing type with stainless steel pin. The door leaf and jamb leaf shall be fully mortised. Vertical door loads shall be carried on minimum 3/4" bearings through a full 180 degrees. The door leaf and jamb leaf shall have template screw hole locations for future replacement needs.

2.6 OPERATING DOOR TRIM

A. Door Bolts

1. Acceptable Products:

a.	Ives:	FB358/FB458	FB31/FB41	DP1/DP2
b.	Rockwood:	557/555	1842/1948	570
c.	Hager:	283D/282D	282D/291D	280X
d.	Trimco:	3915/3917	3810/3815	3910/3911

2. Requirements:

- a. Provide bolt model recommended by manufacturer for door material type.
- b. Provide 1 inch throw stainless steel bolt with 12 inch length unless otherwise scheduled in the sets.
- c. Provide a dust proof strike for bottom bolt at all locations where there is not a threshold.

B. Coordinators

1. Acceptable Products:

a.	Ives:	COR x FL	MB
b.	Rockwood:	1600 Series	1601 Series
c.	Hager:	297 Series	297 Series
d.	Trimco:	3094	3095

2. Requirements:

- a. Provide bar type coordinator and filler bar of size as recommended by manufacturer for each opening.
- b. Provide mounting brackets as required for soffit mounted hardware to be compatible with coordinator.

C. Push Plates, Pull Plates, and Pulls

1. Acceptable Products:

a.	Ives:	8200	8305
b.	Rockwood:	70C	111x70C
c.	Hager:	30S	31J

d. Trimco: 1001 1018

2. Requirements:

- a. Push Plate: Provide 6 inch by 16 inch by .050 inch push plate constructed of stainless steel. Bevel all four edges.
- b. Pull Plate: Provide 4 inch by 16 inch by .050 inch push plate constructed of stainless steel, bevel all four edges. Provide 10 inch center to center (CTC) pull constructed of stainless steel with a diameter of 1 inch.

D. Decorative Door Pulls

1. Acceptable Products:

- a. Ives: 9264F
- b. Rockwood: RM3311
- c. Burns: VP4251

2. Requirements:

- a. Provide door pulls 1-1/4 inch diameter with flat tips. Pull shall be constructed of brass, bronze, or stainless steel.
- b. Provide pull length and shape as indicated in the sets.

2.7 ELECTRIC STRIKES

A. Acceptable Products:

1. Von Duprin: 6300 Series 6000 Series
2. HES: 9000 Series 1006 Series

B. Requirements:

1. Provide electric strikes that are continuous duty rated without the use of external rectifiers.
2. Provide electric strikes with function (fail safe, fail secure) and power requirements as scheduled.
3. Where scheduled, provide electric strikes with monitor switches.

2.8 LOCKS AND LATCHES

A. Mortise Locks

1. Acceptable Products:

- a. Schlage: L Series, 12A Trim Design
- b. Owner's Standard

2. Requirements:

- a. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case.

- b. Where specified, provide indicator window measuring a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
 - 1) Occupied Indicator: Provide indicator above cylinder for visibility while operating the lock that identifies the trim as occupied/unoccupied status of the door. Indicator in unoccupied state has a white background with black text and icon. Indicator in the occupied state has a red background with white text and icon.
 - c. Provide locks with standard 2-3/4 inches backset with full 3/4 inch throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch throw, constructed of stainless steel.
 - d. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - e. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
 - f. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:
 - 1) Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.
 - 2) Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
 - 3) Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - 4) Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - 5) Request to Exit Switch (RX) –
 - i. Modular Design – provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.
 - ii. Monitoring – where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.
 - 6) Connections – provide quick-connect Molex system standard.
 - 7) UL Listed – 3 hour fire door
2. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
- a. Deadbolt: Shall be constructed of stainless steel and include security roller pins. Shall have a minimum 1 inch throw.
 - b. Spring Cages: Lock shall have individual external spring cages for each lever.
 - c. Lever Spindles: Provide lockset with independent, breakaway type lever spindles. Spindles that are continuous through the lock case are not acceptable.
 - d. Hub Blocking: Provide lockset with a hub blocking plate to resist unauthorized entry.
 - e. Vandal Resistant Lever: Where scheduled, provide lockset with lever that freely rotates even when locked to resist vandalism and abuse.
 - f. Thumbturns: Provide thumbturns as enlarged, ADA designated style thumbturns.
 - g. Visual Indicator: Where scheduled, provide visual indicator showing “Vacant” or “Occupied”.

B. Hospital Locks

1. Acceptable Products:

- | | | |
|----|----------------|-------------|
| a. | Glynn Johnson: | HL-6 Series |
| b. | Trimco: | 1500 Series |
| c. | ABH: | 6000 Series |

2. Requirements:

- a. Provide lock chassis type and function as scheduled.

2.9 MAGNETIC LOCKS

A. General

1. Provide magnetic locks complying with BHMA/ANSI A156.23.
2. Where scheduled, provide magnetic locks with fully-concealed SPDT magnetic bond sensing and SPDT door status monitoring devices.
3. Provide fasteners, mounting brackets, and spacer bars as required for proper installation for each application.
4. Provide magnetic locks with complete assemblies of controls, switches, power supplies, relays, and other items required to meet egress code requirements.

B. High Security Magnetic Locks

1. Acceptable Products:

- | | | | |
|----|-------------------------|-------------|----------------|
| a. | Schlage Electronics: | M490 Series | M490DE Series |
| b. | Security Door Controls: | 1510 Series | 1511S/T Series |
| c. | Securitron: | M82 Series | iMXDa Series |

2. Requirements:

- a. Provide minimum holding force of 1,500 pounds.

2.10 CYLINDERS AND CORES

A. Provided by Owner

B. Requirements:

- a. Temporary Construction Keying: Provide each cylinder housing and/or lock lever with keyed construction core during the construction period. Cores will remain property of the contractor and will be returned upon installation of owner's permanent key system.

2.11 EXIT DEVICES

A. Acceptable Products:

1. Von Duprin: 98/35A Series
2. Owner's Standard

B. Requirements:

1. ANSI Grade: BHMA/ANSI A156.3, Grade 1.

2. Device Construction:
 - a. Exit device(s) shall have a mechanism case constructed of extruded aluminum, base plates constructed of cold rolled or cast steel, push pad of extruded aluminum with stainless steel covering or wrought stainless steel, and end caps with flush mounted, sloped design. At full-glass doors, provide exit devices with no exposed fasteners or rivets visible through glass. Where required by stile width, provide narrow-stile type device.
 - b. Latchbolt: Provide Pullman-type deadlocking latch bolts constructed of stainless steel. Where specified provide high security Pullman-type latchbolt that collapses to be square faced under high pull forces. Latch return springs shall be compression type. Tension and Torsion latch return springs are not acceptable. Latchbolts to be mollydagged.
 - c. Dogging Mechanism: where dogging or latch-retraction options are not specifically scheduled for non-fire rated doors, provide device with a hex-key activated hook-type dogging mechanism constructed of steel.
 - d. Plastic or nylon used for the push pad, or parts in the dogging mechanism or latchbolt mechanism are unacceptable.
 - e. Sound Dampening: Device shall be provided with factory-installed sound dampening materials.
 - f. Provide device type, function, and trim style as indicated in hardware schedules.
3. Where exit device(s) are provided for fire rated door, provide with fire listing and label indicating "Fire Exit Hardware". If device is mounted on wood doors, provide sex nuts and bolts.
4. Provide shim kits, filler plates, and other accessories as required for each opening.
5. Unless otherwise indicated in the sets, provide device with roller-type strike.
6. Where scheduled, provide removable mullions by same manufacturer as provided exit devices. Provide mullion stabilizers, key removable option, strike preps, and fire rating as indicated in sets.
7. Concealed vertical exit devices shall be a cable-actuated concealed vertical latch system available in two-point and less bottom latch (LBL) configurations. Vertical rods are not acceptable where concealed cables are scheduled.
 - a. Cable shall include color-coded stainless steel with polytetrafluoroethylene (Teflon®) liner and stainless steel core wire. Latches and center slides are color coded to aid in installation. Conduit and core wire ends snap into latch and center slides without the use of tools. Latchbolts and blocking cams shall be manufactured from sintered metal low carbon copper- infiltrated steel, with a molybdenum disulfide coating for low friction and consistent performance.
 - b. Top latchbolt shall have a minimum 0.382 inch and greater than 90 degree engagement with strike to prevent door and frame separation under high static load. Bottom latchbolt, when used, shall have a minimum of 0.44 inch engagement with strike.
 - c. Product cycle life shall exceed 1,000,000 cycles.
 - d. Latch release does not require separate trigger mechanism.
 - e. Top and bottom latch must operate independently of each other. Top latch will fully engage top strike even when bottom latch is compromised.
 - f. Cable and latching system shall have the ability to:
 - 1) Be assembled as a complete assembly and function prior to being installed in the door.
 - 2) Install into the door as a one-piece single assembly
 - 3) Be installed independently of device installation and function on door even prior to device and trim installation.
 - 4) Connect to the exit device at a single attachment point.

- 5) Adjust bottom latch height from a single point, after the system is installed and connected to exit device, while the door is hanging
- 6) Alter latch position up and down within two-inches without additional adjustment.
- 7) Ability to remove the system while door is hanging.
- 8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
- 9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.

2.12 MECHANICAL DOOR CLOSERS

A. General:

1. Valves: Closers shall have separate valves for latch speed, main speed, and back check. Valves shall be staked to prevent accidental removal. Internal Pressure Relief Valves (PRVs) are prohibited. Provide closers at exterior doors with "Advanced Variable Backcheck" for further protection from wind and abuse forces.
2. Provide the appropriate closer body, handing, and brackets to mount closer inside the building on the least-public side of the door.
 - a. Where closers are to be mounted parallel arm, provide with heavy duty, fully forged arms.
 - b. Where closers are to be mounted regular arm and the opening can otherwise be opened to 180 degrees, provide closer with the appropriate special templating to allow 180 degree door swing. Where a special template is not available for 180 degree swing, provide closer arm with integrated stop.
3. Integrated Stop Closer Arms: Where a closer with integrated stop is required, provide the appropriate closer and arm as follows:
 - a. Parallel arm with spring-cushioned stop arm: Provide where door is otherwise able to open to 95 degrees and requires a parallel arm mount closer.
 - b. Parallel arm with dead stop arm: Provide where door is obstructed from opening to 95 degrees and requires a parallel arm mount closer.
 - c. Regular arm with push side surface-mounted overhead stop: Provide where door closer should mount on pull side of door.
4. Hold Open Arms: Provide closer arms with mechanical hold-opens as scheduled.
5. Provide closers with any special templates, brackets, plates, or other accessories required for interface with header, door, wall, and other hardware. Provide closers with screw packs containing thru-bolts, machine screws, and wood screws.
6. Closers to be application specific. Handed and sized appropriate to the opening.
7. Closers shall be provided with all-weather fluid and shall not require readjustment from 120 degrees F to -30 degrees F. Fluid shall be non-flaming and shall not fuel door or floor covering fires. Upon request, provide data indicating thermal properties of fluid.
8. Closers shall close and latch door when adjusted to meet accessibility requirements for door opening force: 8.5 lbs at exterior doors, 5 lbs at interior doors, and 15 lbs at labeled fire doors.

B. Heavy Duty Door Closers:

1. Acceptable Products:

- a. LCN: 4040XP
 - b. Owner's Standard
2. Requirements:
- a. ANSI Grade: BHMA/ANSI A156.4, Grade 1.
 - b. Closer Construction: Closer shall have cast iron body with 1-1/2 inch steel piston, double heat treated pinion, 5/8 inch bearing journals, and full complement needle or caged ball bearings. Closer shall be adjustable from sizes 1 through 6.
 - c. Provide closers with spring size adjustment dial for ease of adjusting.
- C. Closer Release Devices
1. Acceptable Products:
- a. LCN: SEM7800 Series
 - b. Rixson: 900 Series
 - c. ABH: 2000 Series
 - d. Sargent: 1500 Series
2. Requirements:
- a. Provide 35 pound electro-magnetic hold open device constructed of die cast metal or plastic. Electromagnet shall accept 120VAC, 24VDC, and/or 12VDC power from fire alarm. Provide mounting style as scheduled.
 - b. Provide 400 pound electro-magnetic hold open device where scheduled.

2.13 AUTOMATIC OPERATORS

A. Automatic Operators

1. Acceptable Products:
- a. Stanley: Magic Force
 - b. Owner's Standard
2. Requirements:
- a. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI A156.19.
 - 1) Opening: Powered by DC motor working through reduction gears.
 - 2) Closing: Spring force.
 - 3) Manual, hydraulic, or chain drive closers: Not permitted.
 - 4) Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - b. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
 - c. Provide drop plates, brackets, or adapters for arms as required to suit details.
 - d. Provide motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.

- e. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf.

2.14 ARCHITECTURAL DOOR TRIM

A. Protection Plates and Edge Guards

1. Acceptable Products:

- a. Ives: 8400 Series
- b. Rockwood: K1050
- c. Hager: 194S
- d. Trimco: K Series

2. Requirements:

- a. Provide .050 inch thick stainless steel protection plates with height as scheduled. Plate shall have four beveled edges and countersunk screws. Provide plate with width as follows:
 - 1) Pairs of Doors: Provide plate to be 1 inch less door width.
 - 2) Single Doors: Provide plate to be 2 inches less door width on push side, pull side mounted plates to be 1 inch less door width.

B. Door Stops and Holders

1. Acceptable Products:

- | | | | |
|--------------|-----------|-------|-------|
| a. Ives: | WS406/407 | FS18S | FS439 |
| b. Rockwood: | 405/406 | 466 | 441H |
| c. Hager: | 236W | 269F | 242F |
| d. Trimco: | 1270 | 1209 | W1211 |

2. Requirements:

- a. Provide stops and holders as indicated in the hardware sets.
- b. Where wall bumpers are scheduled, provide concave rubber bumper where the adjacent lever trim incorporates a push-button. Otherwise, provide convex rubber bumpers.

2.15 OVERHEAD STOPS AND HOLDERS

A. Acceptable Products:

- | | | |
|---------------------|-------------|-------------|
| 1. Glynn Johnson: | 100 Series | 90 Series |
| 2. Rixson-Firemark: | 6 Series | 9 Series |
| 3. ABH: | 1000 Series | 9000 Series |
| 4. Sargent: | 100 Series | 90 Series |

B. Requirements:

- 1. Provide overhead stops and holders as scheduled, sized per manufacturer's recommendations based on door width.
- 2. Provide concealed overhead stops with adjustable jamb bracket.

3. Where possible without conflicting with other hardware, mount surface overhead stops on least public side of door.
4. Provide stops with any special templates, brackets, plates, or other accessories required for interface with header, door, wall, and other hardware.

2.16 SADDLE AND PANIC THRESHOLDS

A. Acceptable Products:

- | | |
|------------------------|-------|
| 1. Zero International: | 655A |
| 2. National Guard: | 425HD |
| 3. Pemko: | 1715A |

B. Requirements:

1. Saddle thresholds: Provide with length equal to the width of the opening.
2. Panic thresholds: Provide with length equal to the overall frame width. Provide with mitered and welded ends.
3. Where floor closers are scheduled with thresholds, provide threshold with factory cut outs to be compatible with the provided floor closer.
4. Provide stainless steel machine screws and lead anchors for each threshold.

2.17 WEATHERSTRIP AND GASKET

A. General:

1. Provide weather strip and gasketing as scheduled.
2. Size weather strip and gasket to provide a continuous seal around opening and at meeting stiles.

B. Perimeter Seals

1. Acceptable Products:

- | | | | |
|--------------------|--------|---------|---------|
| a. Zero: | 429A | 488S-BK | 188S-BK |
| b. National Guard: | 700SA | 2525B | 5050B |
| c. Pemko: | 2891AS | PK33D | S88D |

C. Astragals, Meeting Stiles, and Mullion Seals

1. Acceptable Products:

- | | |
|--------------------|------|
| a. Zero: | 43SP |
| b. National Guard: | 139A |
| c. Pemko: | 357C |

2. Requirements

- a. Where overlapping astragals are scheduled on exterior doors, provide with thru-bolts.
- b. Where overlapping astragals are scheduled on out-swinging doors, provide for mounting on the pull-side of the active leaf. Otherwise, provide for mounting on the push-side of the inactive leaf.

D. Door Bottoms

1. Acceptable Products:
 - a. Zero: 360AA 39A
 - b. National Guard: 4447SA 200NA
 - c. Pemko: 434NA 3452CNB

2.18 MISCELLANEOUS HARDWARE

A. Silencers

1. Acceptable Products:
 - a. Ives: SR64
 - b. Rockwood: 608
 - c. Hager: 307D
 - d. Trimco: 1229A
2. Requirements:
 - a. Where indicated on single openings, provide 3 each rubber silencers on lock jamb.
 - b. Where indicated on paired openings, provide 2 each rubber silencers on header.

2.19 ELECTRONIC ACCESSORIES

A. Power Supplies

1. Acceptable Products:
 - a. Schlage Electronics: PS900 Series
2. Requirements:
 - a. Provide power supplies, recommended and approved by the manufacturer of the electrified locking component, for the operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring a power supply.
 - b. Provide the appropriate quantity of power supplies necessary for the proper operation of the electrified locking component and/or components as recommended by the manufacturer of the electrified locking components with consideration for each electrified component utilizing the power supply, the location of the power supply, and the approved wiring diagrams. Locate the power supplies as directed by the Architect.
 - c. Provide a power supply that is regulated and filtered 24 VDC, or as required, and UL class 2 listed.
 - d. Options: Provide the following options.
 - 1) Provide a power supply, where specified, with the internal capability of charging optional sealed backup batteries 24 VDC, or as required, in addition to operating the DC load.
 - 2) Provide sealed batteries for battery back-up at each power supply where scheduled.
 - 3) Provide keyed power supply cabinet.
 - 4) Provide a power supply complete requiring only 120VAC to the fused input and shall be supplied in an enclosure.

- e. Provide a power supply with emergency release terminals, where required, that allow the release of all devices upon activation of the fire alarm system complete with fire alarm input for initiating “no delay” exiting mode.

B. Electric Power Transfers

1. Acceptable Products:

- a. Von Duprin: EPT-10
- b. Falcon: EPT-10
- c. Securitron: CEPT

2. Requirements:

- a. Provide edge-mounted electric power transfer with either two 18 gauge wires or ten 24 gauge wires as scheduled.
- b. Provide transfer capable of carrying a 16 Amp current for a minimum of .3 seconds.

C. Door Contacts

1. Acceptable Products:

- a. Schlage Electronics: 679-05 7764
- b. Securitron: DPS Series --
- c. Security Door Controls: MC-4 MC-4M

2. Requirements:

- a. Provide concealed, edge-mounted door contacts as appropriate for door/frame material.
- b. Provide 7764 door contacts where scheduled on fire rated openings, otherwise provide 679-05 switches.

D. Motion Sensors

1. Acceptable Products:

- a. Schlage Electronics: SCAN II
- b. Securitron: XMS Series
- c. Security Door Controls: MD31 Series

2. Requirements:

- a. Provide surface mounted infrared motion sensor as indicated in the sets.

2.20 HIGH SECURITY EMERGENCY KEY BOX

A. Acceptable Products:

- 1. Knox, Inc. 3200 Series x RMK

B. Requirements:

- 1. Provide recess-mounted emergency key box as approved by the local fire jurisdiction. Key box to be master-keyed as dictated by local fire jurisdiction.

2.21 FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or locksets).
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
- D. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.
 - 1. Brushed Chrome and/or Stainless Steel Appearance
 - a. Brushed Stainless Steel, no coating: ANSI 630.
 - b. Satin Chrome, Clear Coated: ANSI 626, ANSI 652.
 - c. Powder Coated Aluminum finish: ANSI 689.
 - d. Saddle and Panic Thresholds: Mill Aluminum finish.
 - e. Weatherstrip and Gasket: Clear Anodized Aluminum finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

3.3 INSTALLATION

- A. Pre-installation conference shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturer's representatives. A separate pre-installation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and

coordination with other work. Notify participants at least ten, 10 working days before conference.

- B. Hardware Installers must have a minimum of five (5) years' experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.
- C. Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.
- D. Install head seal prior to installation of "PA"-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.
- E. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
- F. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Furnish wiring diagrams to electrical contractor for use in installing electrical hardware products.
 - 1. Electrical contractor to run all wiring and make all final connections for electrified hardware. Hardware supplier shall be responsible to furnish all wiring diagrams to operate electrified hardware. Access control material and electrified hardware to interface at junction boxes.
- H. Boxed Power Supplies: Locate power supplies as indicated. Verify location with Architect.
 - 1. Configuration: Provide one power supply for each door opening.
 - 2. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.
- I. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Architect shall engage a qualified Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

- B. Architectural Hardware Consultant shall inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SETS

- A. The following schedule of hardware sets shall be considered a guide and the supplier is cautioned to refer to general conditions, special conditions, and the full requirements of this section. It shall be the hardware supplier's responsibility to furnish all required hardware.
- B. Where items of hardware are not definitely or correctly specified and are required for completion of the Work, a written statement of such omission, error, conflict, or other discrepancy shall be sent to the Architect, prior to date specified for receipt of bids, for clarification by addendum.
- C. Adjustments to the Contract Sum will not be allowed for omissions or items of hardware not clarified prior to bid opening.

HW SET: 01

DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)

A3270, A3250, A3230, A3210,
A3310, A3330, A3350, A3370

2	EA	CONT. HINGE	224HD	628	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080L 12A	626	SCH
1	EA	FSIC MORTISE CYL	BY OWNER		B/O
1	EA	COORDINATOR	COR X FL	US28	IVE
2	EA	MOUNTING BRACKET	MB1	SP28	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH TBWMS	689	LCN
1	EA	GASKETING	188SBK PSA (ASTRAGAL)	BK	ZER
1	EA	GASKETING	488SBK PSA (PERIMETER)	BK	ZER
1	EA	ASTRAGAL	43SP (ACTIVE LEAF, PULL SIDE)	SP	ZER

END OF SECTION 087100

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Sections include the following:
 - 1. Division 09 Section "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- D. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

- E. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from [UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency] <Insert testing agency>.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Product: As indicated in Finish Schedule on Drawings.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

L. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard antimicrobial gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. 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. Available Manufacturers: (Match existing building standards)

- a. Armstrong World Industries, Inc.
 - 1) Prelude Exposed Tee
- b. Chicago Metallic Corporation.

- c. USG Corporation.
 - 1) Donn DX/DXL 15/16".
 - 2. Structural Classification: Heavy-duty system.
 - 3. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 4. Face Design: Flat, flush.
 - 5. Cap Material: Cold-rolled steel or aluminum.
 - 6. Cap Finish: White as indicated in schedule.
 - 7. Location: As indicated on Drawings.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.;
 - 2. BPB USA;
 - 3. Chicago Metallic Corporation;
 - 4. Fry Reglet Corporation;
 - 5. Gordon, Inc.;
 - 6. USG Interiors, Inc.
- C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide [stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member] <Insert description>.
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical Sealant for Concealed Joints:
 - a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
 - b. Pecora Corporation; BA-98.

- c. Tremco, Inc.; Tremco Acoustical Sealant.
- C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant[, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),] recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 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 to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts,

- eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 9. Do not attach hangers to steel deck tabs.
 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to long axis of space.
 - c. Install panels in a basket-weave pattern.
 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. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

PHASE I & II

SECTION 096510- FLOOR PREPARATION: NEW CONSTRUCTION WITH RESILIENT FLOORING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Floor preparation for Resilient Sheet Flooring & Resilient Tile Flooring The product and this section is only intended to be used for filling voids, cracks and leveling. It is not intended to be a complete floor coating.

B. Related Sections include the following:

1. Division 9 Section "096516 Resilient Sheet Flooring"
2. Division 9 Section "096519 Resilient Tile Flooring"

1.3 SUBMITTALS

A. Product Data: for each type of product indicated. Include manufacture's written data on physical characteristic, durability, and fade resistance. Include installation recommendations for each type of substrate required.

1.4 PROJECT CONDITIONS

A. Worker Qualifications: and experienced resilient installation mechanic or installer who is certified by the Floor Covering manufacture in floor preparation.

1.5 PROJECT CONDITONS

A. General: comply with CRI 104, Section 6.1, "Site Conditions: temperature and Humidity."

B. Complete scope of work for this section based on existing conditions observed at mandatory pre-bid walk through. Make sure work is in compliance with ASTM F 710-03 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. **The product is only to be used for filling voids, cracks and leveling. It is not intended to be a complete floor coating.**

C. Substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

PART 2 – PRODUCTS

2.1 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic- cement based formulation provide by Ardex Engineered Cements, contact Ryan Fortune at 303-507-2666.

PHASE I & II

1. **Ardex Feather Finish**

(use to finish all areas that require floor patch and are not self-leveled)

2. **Ardex P51 Primer**

(prime area to be self-leveled per Ardex's installation instructions)

3. **Ardex V1200 Self Leveling Underlayment**

(level areas where self-leveling is required)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and installation tolerances, and other conditions affecting resilient flooring performance:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the Owner's carpet supplier.
2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
3. Drywall mud, paints, mastics adhesives and overspray are scraped down to bare slab to eliminate any conditions detrimental to carpet glue adhesion.

B. Correct unsatisfactory conditions prior to releasing the slab to the resilient flooring installer.

3.2 PREPARATION

A. General: Comply with ASTM F 710-03, and resilient manufacture's written installation instructions for preparing substrates indicated to receive resilient installation.

B. Use trowelable leveling and patching compounds specified above, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates

1. Bring deep depressions up to floor slab level with fill, applied in thicknesses or multiple layers to comply with manufacturer's instructions.

C. broom and vacuum clean substrates to be covered upon completion of surface preparation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Installation will proceed only after unsatisfactory conditions have been corrected.

End of section 095610

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.

1.3 ACTION SUBMITTALS

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

- B. Sustainable Design Submittals:

- 1. Product Data: For adhesives, indicating VOC content.
- 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- 3. Laboratory Test Reports: For resilient **base**, indicating compliance with requirements for low-emitting materials.

- C. Samples: For each exposed product and for each color and texture specified, not less than **12 inches (300 mm)** long.

- D. Samples for Initial Selection: For each type of product indicated.

- E. 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 (300 mm)** long.

- F. Product Schedule: For resilient base and accessory products. **Use same designations indicated on Drawings. "RB1"**

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 **10 linear feet (3 linear m)** for every **500 linear feet (150 linear m)** or fraction thereof, 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 (10 deg C)** or more than **90 deg F (32 deg C)**.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F (21 deg C)** or more than **95 deg F (35 deg C)**, 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 (13 deg C)** or more than **95 deg F (35 deg C)**.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Resilient **base** 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."

2.2 THERMOSET-RUBBER BASE(R-B1)

- A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
 - 1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 2. Flexco.
 - 3. Roppe Corporation, USA. (Basis of Design)
- B. Product Standard: ASTM F 1861, Type TS (rubber, Group I (solid)).
 - 1. Style and Location:
 - a. See designation on AI drawing sheets.
- C. Thickness: **0.125 inch (3.2 mm)**.
- D. Height: **4 inches (102 mm)**.
- E. Lengths: **Coils in manufacturer's standard length.**

- F. Outside Corners: **Job formed.**
- G. Inside Corners: **Job formed.**
- H. Colors: See RB1 designation on AI drawing sheets.

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-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.

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. 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.
- C. 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. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than **3 inches (76 mm)** in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than **3 inches (76 mm)** in length.
 - a. **Miter** corners to minimize open joints.

3.4 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.

END OF SECTION 096513

BLANK PAGE

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 **rubber** sheet flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Section 018113.13 "Sustainable Design Requirements" for requirements of this section. For recycle content both post and pre-consumer percentages and adhesive materials
- C. 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.
- D. 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 (150-by-230-mm)** sections.
- E. Samples for Initial Selection: For each type of resilient sheet flooring indicated.
- F. Samples for Verification: In manufacturer's standard size, but not less than **6-by-9-inch (150-by-230-mm)** sections of each different color and pattern of resilient sheet flooring required.
- G. Product Schedule: For resilient sheet flooring. **Use same designations indicated on Drawings.**
 - 1. Rubber Flooring (RS) shown on the AI drawing sheets

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of resilient sheet flooring 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. Resilient Sheet Flooring: Furnish not less than **10 linear feet (3 linear m)** for every **500 linear feet (150 linear m)** or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring 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 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.

1.8 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 (10 deg C)** or more than **90 deg F (32 deg C)**. Store rolls upright.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F (21 deg C)** or more than **85 deg F (29 deg C)**, 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 (13 deg C)** or more than **95 deg F (35 deg C)**.
- 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

- A. Fire-Test-Response Characteristics: For resilient sheet 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.

2.2 UNBACKED RUBBER SHEET FLOORING (FC3)

- 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. **Nora Systems, Inc.(Basis of Design)**
 2. Mondo
- B. Product Standard: ASTM F 1859.
1. Type: **Type I (homogeneous rubber sheet)**.
 2. Thickness: **As standard with manufacturer.**
 3. Hardness: **Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240.**
- C. Wearing Surface: **Smooth**
- D. Sheet Width: **As standard with manufacturer.**
- E. Seamless-Installation Method: **Cold welded with net seams**
- F. Colors and Patterns: **As shown on AI drawings and floor plans.**

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. See sustainable design requirements in specifications section 018113.13
- C. Seamless-Installation Accessories:
1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
 2. See sustainable design requirements in specifications section 018113.13.
- D. Integral-Flash-Cove-Base Accessories:
1. Cove Strip: **1-inch (25-mm)** radius provided or approved by resilient sheet flooring manufacturer.
 2. Cap Strip: **Square metal cap** provided or approved by resilient sheet flooring manufacturer. At sheet vinyl areas.

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. (1.36 kg of water/92.9 sq. m)** 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 (152 mm)** 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. Seamless Installation:
 - 1. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.
- J. Integral-Flash-Cove Base: Cove resilient sheet vinyl flooring **6 inches (152 mm)** up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

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

BLANK PAGE

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. Rubber floor tile.
 - 2. Vinyl composition floor tile. (Anti-static at computer server room)

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals: See specification section 018113.13 for requirements on regional materials, recycle contents and VOC's allowed.
- C. 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.
- D. Samples: Full-size units of each color and pattern of floor tile required.
- E. Samples for Initial Selection: For each type of floor tile indicated.

- F. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- G. Product Schedule:
 - 1. For floor rubber tile (FC7)
 - 2. For VCT anti-static flooring (FC6)

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

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 one box for every **50** boxes or fraction thereof, of each type, color, and pattern of floor tile installed. (One box minimum)

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. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

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 (10 deg C)** or more than **90 deg F (32 deg C)**. 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 (21 deg C)** or more than **95 deg F (35 deg C)**, 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 (13 deg C)** or more than **95 deg F (35 deg C)**.
- 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.

2.2 RUBBER FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mondo America Inc. (Basis of Design) Drawing designation (Zeus, Z636)
 - 2. Nora Rubber Flooring, Freudenberg Building Systems, Inc.

- B. Tile Standard: ASTM F 1344,
- C. Hardness: **Manufacturer's standard hardness**, measured using Shore, Type A durometer per ASTM D 2240.
- D. Wearing Surface: **Smooth**.
- E. Thickness: **0.125 inch (3.2 mm)**.
- F. Size: **24 by 24 inches (610 by 610 mm)**.
- G. Colors and Patterns: **As indicated in AI drawings – product # (FC7)**

2.3 VINYL COMPOSITION FLOOR TILE (FC6)

- 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. American Biltrite.
 - 2. Armstrong World Industries, Inc.
 - 3. Congoleum Corporation.
- B. Tile Standard: ASTM F 1066.
- C. Wearing Surface: **Smooth**.
- D. Anti Static VCT tiles
- E. Thickness: **0.125 inch (3.2 mm)**.
- F. Size: **12 by 12 inches (305 by 305 mm)**.
- G. Colors and Patterns: **As indicated in AI drawings – product # (FC6). Product to be selected.**

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by 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. Meet the VOC requirements listed in specification section 018113.13
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer. (VCT tiles only)

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. (1.36 kg of water/92.9 sq. m)** 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 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 **square with room axis** or **in pattern indicated**.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles **with grain running in one direction**.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to 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. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply **two** coats on VCT tile.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099123 - INTERIOR PAINTING

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

This Section is intended to be edited using ARCOM's SpecBuilder and the MPI Architectural Painting Decision Tree, located at www.ARCOMone.com/MPI. **<Double click here to connect.>**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on ~~interior substrates.~~ [the following interior substrates:]

- ~~1. Concrete.~~
- ~~2. Cement board.~~
- ~~3. Clay masonry.~~
- ~~4. Concrete masonry units (CMUs).~~
- ~~5.1. Steel and iron.~~
- ~~6.2. Galvanized metal.~~
- ~~7. Aluminum (not anodized or otherwise coated).~~
- ~~8. Copper.~~
- ~~9. Stainless steel.~~
- ~~10. Wood.~~

- ~~11. — Fiberglass.~~
- ~~12. — Plastic.~~
- ~~13.3. Gypsum board.~~
- ~~14.4. Hollow metal doors and frames.~~
- ~~15. — Plaster.~~
- ~~16. — Acoustic panels and tiles.~~
- ~~17. — Spray-textured ceilings.~~
- ~~18. — Cotton or canvas insulation covering.~~
- ~~19. — ASJ insulation covering.~~
- ~~20. — Bituminous-coated surfaces.~~

~~B. — Related Requirements:~~

- ~~1. — [Section 051200 "Structural Steel Framing"] [Section 051213 "Architecturally Exposed Structural Steel Framing"] for shop priming structural steel.~~
- ~~2. — Section 055000 "Metal Fabrications" for shop priming metal fabrications.~~
- ~~3. — Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.~~
- ~~4. — Section 055116 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.~~
- ~~5. — Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.~~
- ~~6. — Section 055213 "Pipe and Tube Railings" for shop [priming] [painting] pipe and tube railings.~~
- ~~7. — [Section 055313 "Bar Gratings"] [Section 055316 "Plank Gratings"] [Section 055319 "Expanded Metal Gratings"] for shop priming metal gratings.~~
- ~~8. — Section 099600 "High-Performance Coatings" for tile-like coatings.~~
- ~~9. — Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.~~

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- 2. Indicate VOC content.

~~B. Sustainable Design Submittals:~~

- 1. ~~<Double click to insert sustainable design text for paints and coatings.>~~

~~C.B. Samples for Initial Selection:~~ For each type of topcoat product.

~~D.C. Samples for Verification:~~ For each type of paint system and in each color and gloss of topcoat.

- 1. Submit Samples on rigid backing, 8 inches square.
- 2. Apply coats on Samples in steps to show each coat required for system.
- 3. Label each coat of each Sample.
- 4. Label each Sample for location and application area.

~~E.D. 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: [5] ~~<Insert number>~~ percent, but not less than [1 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:~~

- ~~Benjamin Moore & Co. (Bases of Design)~~
- ~~ICI Paints.~~
- ~~Kelly Moore Paints.~~
- ~~M.A.B. Paints.~~
- 1. PPG Architectural Finishes, Inc.
- 2. Sherwin-Williams Company (The).
- ~~Redda Paint~~

~~A. <Double click here to find, evaluate, and insert list of manufacturers and products.>~~

~~B. Products: Subject to compliance with requirements, [provide product] [provide one of the products] [available products that may be incorporated into the Work include, but are not limited to products] listed in the Interior Painting Schedule for the paint category indicated.~~

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

~~C. <Double click to insert sustainable design text for paints.>~~

~~D.C. Colors: - [As selected by Architect from manufacturer's full range] [Match Architect's samples] [As indicated in a color schedule] <Insert requirements> As indicated in the Finish Schedule on Drawings.~~

- ~~1. [Ten] [Twenty] [Thirty] <Insert number> percent of surface area will be painted with deep tones.~~

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. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
 5. Gypsum Board: 12 percent.
 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- ~~D. Plaster Substrates: Verify that plaster is fully cured.~~
- ~~E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.~~
- ~~F.D.~~ Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- ~~G.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.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.

- 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.
- ~~I. Aluminum Substrates: Remove loose surface oxidation.~~
- ~~J. Wood Substrates:
 - ~~1. Scrape and clean knots, and apply coat of knot sealer before applying primer.~~
 - ~~2. Sand surfaces that will be exposed to view, and dust off.~~
 - ~~3. Prime edges, ends, faces, undersides, and backsides of wood.~~
 - ~~4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.~~~~
- ~~K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.~~

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. ~~Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:~~

1. ~~Paint the following work where exposed in equipment rooms:~~

- a. ~~Equipment, including panelboards [and switch gear].~~
- b. ~~Uninsulated metal piping.~~
- c. ~~Uninsulated plastic piping.~~
- d. ~~Pipe hangers and supports.~~
- e. ~~Metal conduit.~~
- f. ~~Plastic conduit.~~
- g. ~~Tanks that do not have factory-applied final finishes.~~
- h. ~~Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.~~
- i. ~~<Insert mechanical items to be painted>.~~

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.~~
- i. ~~<Insert mechanical items to be painted>.~~

3. ~~Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.~~

3.4 ~~FIELD QUALITY CONTROL~~

A. ~~Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.~~

- 1. ~~Contractor shall touch up and restore painted surfaces damaged by testing.~~
- 2. ~~If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.~~

3.53.4 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.

This Section is intended to be edited using ARCOM's SpecBuilder and the MPI Architectural Painting Decision Tree, located at www.ARCOMone.com/MPI. <Double click here to connect.>

3.5 INTERIOR PAINTING SCHEDULE

3.6A. Refer to Finish Schedule on Drawings for paint schedule, complying with the specified systems below.

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System [~~MPI INT 3.1A~~] [~~MPI INT 3.1E~~]:

a. Prime Coat: Primer, alkali resistant, water based[, ~~MPI #3~~].

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. Prime Coat: Latex, interior, matching topcoat.

c. Intermediate Coat: Latex, interior, matching topcoat.

d. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, ~~MPI #53~~].

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. Topcoat: Latex, interior (MPI Gloss Level 2)[, ~~MPI #44~~].

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. Topcoat: Latex, interior (MPI Gloss Level 3)[, ~~MPI #52~~].

- 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- g. — Topcoat: Latex, interior (MPI Gloss Level 4)[, ~~MPI #43~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- h. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, ~~MPI #54~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- i. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, ~~MPI #114~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
2. — Latex over Latex Aggregate System [~~MPI INT 3.1B~~]:
 - a. — Prime Coat: Textured coating, latex, flat[, ~~MPI #42~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, ~~MPI #53~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, ~~MPI #44~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, ~~MPI #52~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, ~~MPI #43~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, ~~MPI #54~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, ~~MPI #114~~].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
3. — Latex Aggregate System [~~MPI INT 3.1N~~]:

- a. Prime Coat: As recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
- c. Topcoat: Textured coating, latex, nonflat[, **MPI #41**].

1) <Insert manufacturer's name; product name or designation>.

- d. Topcoat: Textured coating, latex, flat[, **MPI #42**].

1) <Insert manufacturer's name; product name or designation>.

4. Institutional Low-Odor/VOC Latex System [**MPI INT 3.1M**]:

- a. Prime Coat: Primer-sealer, interior, institutional low odor/VOC[, **MPI #149**].

1) <Insert manufacturer's name; product name or designation>.

- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].

1) <Insert manufacturer's name; product name or designation>.

- d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].

1) <Insert manufacturer's name; product name or designation>.

- e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].

1) <Insert manufacturer's name; product name or designation>.

- f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, **MPI #146**].

1) <Insert manufacturer's name; product name or designation>.

- g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, **MPI #147**].

1) <Insert manufacturer's name; product name or designation>.

- h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, **MPI #148**].

- 1) —<Insert manufacturer's name; product name or designation>.
5. —High-Performance Architectural Latex System [MPI INT 3.1C]:
 - a. —Prime Coat: Primer, alkali resistant, water based[, MPI #3].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. —Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. —Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. —Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. —Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. —Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].
 - 1) —<Insert manufacturer's name; product name or designation>.
6. —Water-Based Light Industrial Coating System [MPI INT 3.1L]:
 - a. —Prime Coat: Primer, alkali resistant, water based[, MPI #3].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. —Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. —Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].
 - 1) —<Insert manufacturer's name; product name or designation>.

d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

7. ~~Alkyd System [MPI INT 3.1D]:~~

a. ~~Prime Coat: Primer, alkali resistant, water based[, MPI #3].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Alkyd, interior, matching topcoat.~~

c. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. ~~Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

8. ~~Concrete Stain System [MPI INT 3.1K]:~~

a. ~~First Coat: Stain, interior, matching topcoat.~~

b. ~~Topcoat: Stain, interior[, MPI #58].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

B. ~~Concrete Substrates, Traffic Surfaces:~~

1. ~~Latex Floor Enamel System [MPI INT 3.2A]:~~

a. ~~Prime Coat: Floor paint, latex, matching topcoat.~~

- b. — Intermediate Coat: Floor paint, latex, matching topcoat.
- c. — Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3)[, MPI #60].

1) — <Insert manufacturer's name; product name or designation>.

2. — Alkyd Floor Enamel System [MPI INT 3.2B]:

- a. — Prime Coat: Floor enamel, alkyd, matching topcoat.
- b. — Intermediate Coat: Floor enamel, alkyd, matching topcoat.
- c. — Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6)[, MPI #27].

1) — <Insert manufacturer's name; product name or designation>.

3. — Concrete Stain System [MPI INT 3.2E]:

- a. — First Coat: Stain, interior, for concrete floors, matching topcoat.
- b. — Topcoat: Stain, interior, for concrete floors[, MPI #58].

1) — <Insert manufacturer's name; product name or designation>.

4. — Water-Based Concrete Floor Sealer System [MPI INT 3.2G]:

- a. — First Coat: Sealer, water based, for concrete floors, matching topcoat.
- b. — Topcoat: Sealer, water based, for concrete floors[, MPI #99].

5. — Solvent-Based Concrete Floor Sealer System [MPI INT 3.2F]:

- a. — First Coat: Sealer, solvent based, for concrete floors, matching topcoat.
- b. — Topcoat: Sealer, solvent based, for concrete floors[, MPI #104].

1) — <Insert manufacturer's name; product name or designation>.

C. — Cement Board Substrates:

1. — Latex System [MPI INT 3.3A]:

- a. — Prime Coat: Primer, alkali resistant, water based[, MPI #3].

1) — <Insert manufacturer's name; product name or designation>.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].

1) <Insert manufacturer's name; product name or designation>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].

1) <Insert manufacturer's name; product name or designation>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].

1) <Insert manufacturer's name; product name or designation>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].

1) <Insert manufacturer's name; product name or designation>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].

1) <Insert manufacturer's name; product name or designation>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

1) <Insert manufacturer's name; product name or designation>.

2. Institutional Low-Odor/VOC Latex System [**MPI INT 3.3G**]:

a. Prime Coat: Primer-sealer, interior, institutional low-odor/VOC[, **MPI #149**].

1) <Insert manufacturer's name; product name or designation>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].

1) <Insert manufacturer's name; product name or designation>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].

1) <Insert manufacturer's name; product name or designation>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].

- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: — Latex, — interior, — institutional — low — odor/VOC — (MPI Gloss Level 4)[, **MPI #146**].
- 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, **MPI #147**].
- 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: — Latex, — interior, — institutional — low — odor/VOC, — gloss — (MPI Gloss Level 6)[, **MPI #148**].
- 1) —<Insert manufacturer's name; product name or designation>.
3. — High-Performance Architectural Latex System [**MPI INT 3.3B**]:
- a. — Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
- 1) —<Insert manufacturer's name; product name or designation>.
- b. — Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- c. — Topcoat: — Latex, — interior, — high — performance — architectural — (MPI Gloss Level 2)[, **MPI #138**].
- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: — Latex, — interior, — high — performance — architectural — (MPI Gloss Level 3)[, **MPI #139**].
- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: — Latex, — interior, — high — performance — architectural — (MPI Gloss Level 4)[, **MPI #140**].
- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, **MPI #141**].
- 1) —<Insert manufacturer's name; product name or designation>.
4. — Water-Based Light Industrial Coating System [**MPI INT 3.3H**]:

a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].

1) <Insert manufacturer's name; product name or designation>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, **MPI #151**].

1) <Insert manufacturer's name; product name or designation>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #153**].

1) <Insert manufacturer's name; product name or designation>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, **MPI #154**].

1) <Insert manufacturer's name; product name or designation>.

5. Alkyd System [**MPI INT 3.3C**]:

a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].

1) <Insert manufacturer's name; product name or designation>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, **MPI #49**].

1) <Insert manufacturer's name; product name or designation>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[, **MPI #51**].

1) <Insert manufacturer's name; product name or designation>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #47**].

1) <Insert manufacturer's name; product name or designation>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, **MPI #48**].

1) <Insert manufacturer's name; product name or designation>.

D. Clay Masonry Substrates:

1. Latex System [**MPI INT 4.1A**]:

a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].

1) <Insert manufacturer's name; product name or designation>.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].

1) <Insert manufacturer's name; product name or designation>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].

1) <Insert manufacturer's name; product name or designation>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].

1) <Insert manufacturer's name; product name or designation>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].

1) <Insert manufacturer's name; product name or designation>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].

1) <Insert manufacturer's name; product name or designation>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

1) <Insert manufacturer's name; product name or designation>.

2. Latex Aggregate System [**MPI INT 4.1B**]:

a. Prime Coat: Primer for textured coating, latex, flat[, **as recommended in writing by topcoat manufacturer**].

b. Intermediate Coat: Intermediate coat for textured coating, latex, flat[, **as recommended in writing by topcoat manufacturer**].

c. Topcoat: Textured coating, latex, nonflat[, **MPI #41**].

1) <Insert manufacturer's name; product name or designation>.

d. Topcoat: Textured coating, latex, flat[, **MPI #42**].

- 1) <Insert manufacturer's name; product name or designation>.
3. Institutional Low-Odor/VOC Latex System [MPI INT 4.1M]:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, MPI #149].
 - 1) <Insert manufacturer's name; product name or designation>.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].
 - 1) <Insert manufacturer's name; product name or designation>.
 - d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].
 - 1) <Insert manufacturer's name; product name or designation>.
 - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].
 - 1) <Insert manufacturer's name; product name or designation>.
 - f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].
 - 1) <Insert manufacturer's name; product name or designation>.
 - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].
 - 1) <Insert manufacturer's name; product name or designation>.
 - h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].
 - 1) <Insert manufacturer's name; product name or designation>.
4. High-Performance Architectural Latex System [MPI INT 4.1L]:
 - a. Prime Coat: Primer, alkali resistant, water based[, MPI #3].
 - 1) <Insert manufacturer's name; product name or designation>.

- b. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~
 - c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, **MPI #138**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, **MPI #139**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, **MPI #140**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, **MPI #141**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
5. ~~Water-Based Light Industrial Coating System [**MPI INT 4.1C**]:~~
- a. ~~Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, **MPI #151**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #153**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, **MPI #154**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
6. ~~Alkyd System [**MPI INT 4.1D**]:~~
- a. ~~Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].~~

- 1) —<Insert manufacturer's name; product name or designation>.
- b. — Intermediate Coat: Alkyd, interior, matching topcoat.
- c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].
- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].
- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].
- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].
- 1) —<Insert manufacturer's name; product name or designation>.
- 7. — Clear (2-Component) Polyurethane System [MPI INT 4.1K]:
 - a. — Prime Coat: Two-component polyurethane matching topcoat.
 - b. — Intermediate Coat: Two-component polyurethane matching topcoat.
 - c. — Topcoat: Varnish, aliphatic polyurethane, two-component (MPI Gloss Level 6 or MPI Gloss Level 7)[, MPI #78].
 - 1) —<Insert manufacturer's name; product name or designation>.

E. — CMU Substrates:

- 1. — Latex System [MPI INT 4.2A]:
 - a. — Block Filler: Block filler, latex, interior/exterior[, MPI #4].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

~~Epoxy over Epoxy Sealer System
Heavy duty Block Filler
Pro Industrial Hi-Bild-WB Catalyzed Epoxy
f. Pro Industrial Hi-Bild-WB Catalyzed Epoxy~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~2. Latex Aggregate System [MPI INT 4.2B]:~~

~~a. Prime Coat: Primer for textured coating, latex, flat[, as recommended in writing by topcoat manufacturer].~~

~~b. Intermediate Coat: Intermediate coat for textured coating, latex, flat[, as recommended in writing by topcoat manufacturer].~~

~~c. Topcoat: Textured coating, latex, nonflat[, MPI #41].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~d. Topcoat: Textured coating, latex, flat[, MPI #42].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~3. Institutional Low Odor/VOC Latex System [MPI INT 4.2E]:~~

~~a. Block Filler: Block filler, latex, interior/exterior[, MPI #4].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~

~~c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].~~

- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: — Latex, — interior, — institutional — low — odor/VOC — (MPI Gloss Level 3)[, **MPI #145**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: — Latex, — interior, — institutional — low — odor/VOC — (MPI Gloss Level 4)[, **MPI #146**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: — Latex, — interior, — institutional — low — odor/VOC, — semi-gloss — (MPI Gloss Level 5)[, **MPI #147**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: — Latex, — interior, — institutional — low — odor/VOC, — gloss — (MPI Gloss Level 6)[, **MPI #148**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 4. — High-Performance Architectural Latex System [**MPI INT 4.2D**] [**MPI INT 4.2P**]:
 - a. — Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - c. — Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - d. — Topcoat: — Latex, — interior, — high — performance — architectural — (MPI Gloss Level 2)[, **MPI #138**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: — Latex, — interior, — high — performance — architectural — (MPI Gloss Level 3)[, **MPI #139**].
 - 1) —<Insert manufacturer's name; product name or designation>.

- f. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - g. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
5. ~~Water-Based Light Industrial Coating System [MPI INT 4.2K]:~~
- a. ~~Block Filler: Block filler, latex, interior/exterior[, MPI #4].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
6. ~~Alkyd System [MPI INT 4.2C] [MPI INT 4.2N]:~~
- a. ~~Block Filler: Block filler, latex, interior/exterior[, MPI #4].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Sealer Coat: Primer sealer, latex, interior[, MPI #50].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~

- c. — Intermediate Coat: Alkyd, interior, matching topcoat.
- d. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, **MPI #49**].
 - 1) — <Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, **MPI #51**].
 - 1) — <Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #47**].
 - 1) — <Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, **MPI #48**].
 - 1) — <Insert manufacturer's name; product name or designation>.
- 7. — Clear (2-Component) Polyurethane System [**MPI INT 4.2Q**]:
 - a. — Prime Coat: Two-component polyurethane, matching topcoat.
 - b. — Intermediate Coat: Two-component polyurethane, matching topcoat.
 - c. — Topcoat: Varnish, aliphatic polyurethane, two-component (MPI Gloss Level 6 or MPI Gloss Level 7)[, **MPI #78**].
 - 1) — <Insert manufacturer's name; product name or designation>.

F.B. Steel Substrates:

- 1. — Latex System, Alkyd Primer [**MPI INT 5.1Q**] [**MPI INT 5.1QQ**]:
 - a. — Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - b. — Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - c. — Prime Coat: Shop primer specified in Section where substrate is specified.
 - d. — Intermediate Coat: Latex, interior, matching topcoat.
 - e. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].

- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) —<Insert manufacturer's name; product name or designation>.
- i. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
 - 1) —<Insert manufacturer's name; product name or designation>.
- j. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 2. — Latex over Shop-Applied Quick-Drying Shop-Primer System [MPI INT 5.1X]:
 - a. — Prime Coat: Primer, quick dry, for shop application[, MPI #275].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
 - 1) —<Insert manufacturer's name; product name or designation>.

~~h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~3. Institutional Low-Odor/VOC Latex System [MPI INT 5.1S]:~~

~~a. Prime Coat: Primer, rust-inhibitive, water based[MPI #107].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~

~~c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~4. High-Performance Architectural Latex System [MPI INT 5.1R] [MPI INT 5.1RR]:~~

- a. ~~Prime Coat: Primer, alkyd, quick dry, for metal[, MPI #76].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- b. ~~Prime Coat: Primer, alkyd, anti-corrosive, for metal[, MPI #79].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- c. ~~Prime Coat: Shop primer specified in Section where substrate is specified.~~
- d. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~
- e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- f. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- g. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- h. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- 5. ~~Water-Based Light Industrial Coating System [MPI INT 5.1B]:~~
 - a. ~~Prime Coat: Primer, rust-inhibitive, water based[MPI #107].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].

1) —<Insert manufacturer's name; product name or designation>.

6. — Water-Based Light Industrial Coating System over Epoxy Primer System [MPI INT 5.1N]:

a. — Prime Coat: Primer, epoxy, anti-corrosive[MPI #101].

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. — Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].

1) —<Insert manufacturer's name; product name or designation>.

7. — Water-Based Dry-Fall System [MPI INT 5.1C] [MPI INT 5.1CC]:

a. — Prime Coat: Primer, alkyd, quick dry, for metal[, MPI #76].

1) —<Insert manufacturer's name; product name or designation>.

b. — Prime Coat: Primer, alkyd, anti-corrosive, for metal[, MPI #79].

1) —<Insert manufacturer's name; product name or designation>.

c. — Prime Coat: Shop primer specified in Section where substrate is specified.

d. — Topcoat: Dry fall, latex, flat[, MPI #118].

- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1)[, MPI #133].
- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Dry fall, latex (MPI Gloss Level 3)[, MPI #155].
- 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Dry fall, latex (MPI Gloss Level 5)[, MPI #226].
- 1) —<Insert manufacturer's name; product name or designation>.
8. — Water-Based Dry-Fall over Shop-Applied Quick-Drying Shop-Primer System [MPI INT 5.1CCC]:
- a. — Prime Coat: Primer, quick dry, for shop application[, MPI #275].
- 1) —<Insert manufacturer's name; product name or designation>.
- b. — Topcoat: Dry fall, latex, flat[, MPI #118].
- 1) —<Insert manufacturer's name; product name or designation>.
- c. — Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1)[, MPI #133].
- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Dry fall, latex (MPI Gloss Level 3)[, MPI #155].
- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Dry fall, latex (MPI Gloss Level 5)[, MPI #226].
- 1) —<Insert manufacturer's name; product name or designation>.
9. — Alkyd System [MPI INT 5.1E] [MPI INT 5.1EE]:
- a. — Prime Coat: Primer, alkyd, quick dry, for metal[, MPI #76].
- 1) —<Insert manufacturer's name; product name or designation>.
- b. — Prime Coat: Primer, alkyd, anti-corrosive, for metal[, MPI #79].
- 1) —<Insert manufacturer's name; product name or designation>.
- c. — Prime Coat: Shop primer specified in Section where substrate is specified.

- d. — Intermediate Coat: Alkyd, interior, matching topcoat.
- e. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].
 - 1) — <Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].
 - 1) — <Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].
 - 1) — <Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].
 - 1) — <Insert manufacturer's name; product name or designation>.
- 10. — Alkyd over Surface-Tolerant Primer System [MPI INT 5.1T]:
 - a. — Prime Coat: Primer, metal, surface tolerant[MPI #23].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].
- 11. — Alkyd over Shop-Applied Quick-Drying Shop Primer System [MPI INT 5.1W]:
 - a. — Prime Coat: Primer, quick dry, for shop application[, MPI #275].
 - 1) — <Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Alkyd, interior, matching topcoat.

c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].

1) — <Insert manufacturer's name; product name or designation>.

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].

1) — <Insert manufacturer's name; product name or designation>.

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) — <Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) — <Insert manufacturer's name; product name or designation>.

42.1. Quick-Dry Enamel System [MPI INT 5.1A]:

a. Prime Coat: Primer, alkyd, quick dry, for metal[, MPI #76].

1) — <Insert manufacturer's name; product name or designation>.

b. Intermediate Coat: Alkyd, quick dry, matching topcoat.

c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5)[, MPI #81].

1) — <Insert manufacturer's name; product name or designation>.

d. — Topcoat: Alkyd, quick dry, gloss (MPI Gloss Level 7)[, MPI #96].

1) — <Insert manufacturer's name; product name or designation>.

13. Alkyd Dry-Fall System [MPI INT 5.1D]:

a. — Prime Coat: Primer, alkyd, quick dry, for metal[, MPI #76].

1) — <Insert manufacturer's name; product name or designation>.

b. — Prime Coat: Primer, alkyd, anti-corrosive, for metal[, MPI #79].

1) — <Insert manufacturer's name; product name or designation>.

c. — Prime Coat: Shop primer specified in Section where substrate is specified.

- d. — Topcoat: Dry fall, alkyd, flat[, **MPI #55**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- e. — Topcoat: Dry fall, alkyd (MPI Gloss Level 3)[, **MPI #89**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- f. — Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5)[, **MPI #225**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- 14. — Alkyd Dry-Fall over Quick-Drying Primer System [**MPI INT 5.1DD**]:
 - a. — Prime Coat: Primer, quick dry, for shop application[, **MPI #275**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - b. — Topcoat: Dry fall, alkyd, flat[, **MPI #55**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - c. — Topcoat: Dry fall, alkyd (MPI Gloss Level 3)[, **MPI #89**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - d. — Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5)[, **MPI #225**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
- 15. — Aluminum Paint System [**MPI INT 5.1M**] [**MPI INT 5.1MM**]:
 - a. — Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - b. — Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
 - 1) — ~~<Insert manufacturer's name; product name or designation>.~~
 - c. — Prime Coat: Shop primer specified in Section where substrate is specified.
 - d. — Intermediate Coat: Aluminum paint, matching topcoat.

e. — Topcoat: Aluminum paint[, **MPI #1**].

1) — <Insert manufacturer's name; product name or designation>.

G.C. Galvanized-Metal Substrates:

1. — Latex System [**MPI INT 5.3A**] [**MPI INT 5.3J**]:

a. — Prime Coat: Primer, galvanized, cementitious[, **MPI #26**].

1) — <Insert manufacturer's name; product name or designation>.

b. — Prime Coat: Primer, galvanized, water-based[, **MPI #134**].

1) — <Insert manufacturer's name; product name or designation>.

c. — Intermediate Coat: Latex, interior, matching topcoat.

d. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].

1) — <Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].

1) — <Insert manufacturer's name; product name or designation>.

f. — Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].

1) — <Insert manufacturer's name; product name or designation>.

g. — Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].

1) — <Insert manufacturer's name; product name or designation>.

h. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].

1) — <Insert manufacturer's name; product name or designation>.

i. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

1) — <Insert manufacturer's name; product name or designation>.

2. — Institutional Low-Odor/VOC Latex System [**MPI INT 5.3N**]:

- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - 1) <Insert manufacturer's name; product name or designation>.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].
 - 1) <Insert manufacturer's name; product name or designation>.
- d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].
 - 1) <Insert manufacturer's name; product name or designation>.
- e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].
 - 1) <Insert manufacturer's name; product name or designation>.
- f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, **MPI #146**].
 - 1) <Insert manufacturer's name; product name or designation>.
- g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, **MPI #147**].
 - 1) <Insert manufacturer's name; product name or designation>.
- h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, **MPI #148**].
 - 1) <Insert manufacturer's name; product name or designation>.
3. High-Performance Architectural Latex System [**MPI INT 5.3M**]:
 - a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- 4. ~~Water-Based Light Industrial Coating System [MPI INT 5.3B] [MPI INT 5.3K]:~~
 - a. ~~Prime Coat: Primer, galvanized, cementitious[, MPI #26].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Prime Coat: Primer, galvanized, water based[, MPI #134].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - c. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~

5. ~~Water-Based Dry-Fall System [MPI INT 5.3H]:~~

- a. ~~Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.~~
- b. ~~Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1)[, MPI #133].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

6.1. ~~Alkyd over Cementitious Primer System [MPI INT 5.3C]:~~

- a. ~~Prime Coat: Primer, galvanized, cementitious[, MPI #26].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- b. ~~Intermediate Coat: Alkyd, interior, matching topcoat.~~
- c. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- d. ~~Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- e. ~~Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- f.c. ~~Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

7. ~~Alkyd Dry-Fall System (Cementitious Primer) [MPI INT 5.3F]:~~

- a. ~~Prime Coat: Primer, galvanized, cementitious[, MPI #26].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- b. ~~Topcoat: Dry fall, alkyd, flat[, MPI #55].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- c. ~~Topcoat: Dry fall, alkyd (MPI Gloss Level 3) [, MPI #89].~~
~~1) <Insert manufacturer's name; product name or designation>.~~
- d. ~~Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5)[, MPI #225].~~
~~1) <Insert manufacturer's name; product name or designation>.~~

8. ~~Aluminum Paint System (Cementitious Primer) [MPI INT 5.3G]:~~

- a. ~~Prime Coat: Primer, galvanized, cementitious[, MPI #26].~~

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Aluminum paint, matching topcoat.

c. — Topcoat: Aluminum paint[, MPI #1].

1) —<Insert manufacturer's name; product name or designation>.

H. — Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. — Latex System [MPI INT 5.4H]:

a. — Prime Coat: Primer, quick dry, for aluminum[, MPI #95].

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

1) —<Insert manufacturer's name; product name or designation>.

g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].

1) —<Insert manufacturer's name; product name or designation>.

h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

1) —<Insert manufacturer's name; product name or designation>.

2. — Institutional Low Odor/VOC Latex System [MPI INT 5.4G]:

a. — Prime Coat: Primer, quick dry, for aluminum[, MPI #95].

1) —<Insert manufacturer's name; product name or designation>.

- b. ~~Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~
- c. ~~Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- d. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- e. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- f. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- g. ~~Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- h. ~~Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

3. ~~High-Performance Architectural Latex System [MPI INT 5.4F]:~~

- a. ~~Prime Coat: Primer, quick dry, for aluminum[, MPI #95].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- b. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~

- c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~

- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].
 - 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 4. — Water-Based Light Industrial Coating System [MPI INT 5.4E]:
 - a. — Prime Coat: Primer, quick dry, for aluminum[, MPI #95].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. — Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 5. — Alkyd System [MPI INT 5.4A] [MPI INT 5.4J]:
 - a. — Prime Coat: Primer, vinyl wash[, MPI #80].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Prime Coat: Primer, quick dry, for aluminum[, MPI #95].

- 1) —<Insert manufacturer's name; product name or designation>.
- c. — Intermediate Coat: Alkyd, interior, matching topcoat.
- d. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].
 - 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].
 - 1) —<Insert manufacturer's name; product name or designation>.
- i. — Copper Substrates:
 - 1. — Latex System [MPI INT 5.5H]:
 - a. — Prime Coat: Primer, quick dry, for aluminum[, MPI #95].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].

- 1) ~~<Insert manufacturer's name; product name or designation>.~~
- h. ~~Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~
- 1) ~~<Insert manufacturer's name; product name or designation>.~~
2. ~~Institutional Low-Odor/VOC Latex System [MPI-INT 5.5G]:~~
 - a. ~~Prime Coat: Primer, quick dry, for aluminum[, MPI #95].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~
 - c. ~~Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - g. ~~Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - h. ~~Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
3. ~~High-Performance Architectural Latex System [MPI-INT 5.5F]:~~
 - a. ~~Prime Coat: Primer, quick dry, for aluminum[, MPI #95].~~

- 1) ~~<Insert manufacturer's name; product name or designation>.~~
- b. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~
- c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~
- 1) ~~<Insert manufacturer's name; product name or designation>.~~
- d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
- 1) ~~<Insert manufacturer's name; product name or designation>.~~
- e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
- 1) ~~<Insert manufacturer's name; product name or designation>.~~
- f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
- 1) ~~<Insert manufacturer's name; product name or designation>.~~
4. ~~Water-Based Light Industrial Coating System [MPI INT 5.5E]:~~
 - a. ~~Prime Coat: Primer, quick dry, for aluminum[, MPI #95].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~

5. — Alkyd System [~~MPI INT 5.5A~~]:

a. — Prime Coat: Primer, vinyl wash[, ~~MPI #80~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

b. — Intermediate Coat: Alkyd, interior, matching topcoat.

c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, ~~MPI #49~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, ~~MPI #51~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, ~~MPI #47~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, ~~MPI #48~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

J. — Stainless Steel Substrates:

1. — Latex System [~~MPI INT 5.6H~~]:

a. — Prime Coat: Primer, bonding, solvent based[, ~~MPI #69~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, ~~MPI #53~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, ~~MPI #44~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, ~~MPI #52~~].

1) — ~~<Insert manufacturer's name; product name or designation>.~~

- f. ~~Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - g. ~~Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - h. ~~Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
2. ~~High-Performance Architectural Latex System [MPI INT 5.6G]:~~
- a. ~~Prime Coat: Primer, bonding, solvent based[, MPI #69].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~
 - c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
3. ~~Water-Based Light Industrial Coating System [MPI INT 5.6A] [MPI INT 5.6F]:~~
- a. ~~Prime Coat: Primer, bonding, solvent based[, MPI #69].~~

- 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - c. — Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - d. — Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, **MPI #151**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #153**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, **MPI #154**].
 - 1) —<Insert manufacturer's name; product name or designation>.
4. — Alkyd System [**MPI INT 5.6B**]:
- a. — Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, **MPI #49**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, **MPI #51**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #47**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, **MPI #48**].

1) —<Insert manufacturer's name; product name or designation>.

K. — Wood Substrates: Glued-laminated construction.

1. — Latex over Latex Primer System [MPI INT 6.1M]:

a. — Prime Coat: Primer, latex, for interior wood[, MPI #39].

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

1) —<Insert manufacturer's name; product name or designation>.

g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].

1) —<Insert manufacturer's name; product name or designation>.

h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

1) —<Insert manufacturer's name; product name or designation>.

2. — Latex over Alkyd Primer System [MPI INT 6.1A]:

a. — Prime Coat: Primer sealer, alkyd, interior[, MPI #45].

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 3. — Institutional Low-Odor/VOC Latex System [**MPI INT 6.1Q**]:
 - a. — Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. — Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, **MPI #146**].
 - 1) —<Insert manufacturer's name; product name or designation>.

~~g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~4. High-Performance Architectural Latex System [MPI INT 6.1N]:~~

~~a. Prime Coat: Primer, latex, for interior wood[, MPI #39].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~

~~c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

~~5. Alkyd System [MPI INT 6.1B]:~~

~~a. Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~

~~1) <Insert manufacturer's name; product name or designation>.~~

- b. — Intermediate Coat: Alkyd, interior, matching topcoat.
- c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].
 - 1) — <Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].
 - 1) — <Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].
 - 1) — <Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].
 - 1) — <Insert manufacturer's name; product name or designation>.

L. — Wood Substrates: Exposed framing.

- 1. — Latex over Latex Primer System [MPI INT 6.2D]:
 - a. — Prime Coat: Primer, latex, for interior wood[, MPI #39].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

- 1) ~~—<Insert manufacturer's name; product name or designation>.~~
2. ~~—Latex over Alkyd Primer System [MPI INT 6.2A]:~~
 - a. ~~—Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - b. ~~—Intermediate Coat: Latex, interior, matching topcoat.~~
 - c. ~~—Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - d. ~~—Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - e. ~~—Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - f. ~~—Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - g. ~~—Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - h. ~~—Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
3. ~~—Institutional Low-Odor/VOC Latex System [MPI INT 6.2L]:~~
 - a. ~~—Prime Coat: Primer, latex, for interior wood[, MPI #39].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~
 - b. ~~—Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~
 - c. ~~—Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~
 - 1) ~~—<Insert manufacturer's name; product name or designation>.~~

- d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].
 - 1) <Insert manufacturer's name; product name or designation>.
 - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].
 - 1) <Insert manufacturer's name; product name or designation>.
 - f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].
 - 1) <Insert manufacturer's name; product name or designation>.
 - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].
 - 1) <Insert manufacturer's name; product name or designation>.
 - h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].
 - 1) <Insert manufacturer's name; product name or designation>.
4. High-Performance Architectural Latex System [MPI INT 6.2B]:
- a. Prime Coat: Primer, latex, for interior wood[, MPI #39].
 - 1) <Insert manufacturer's name; product name or designation>.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].
 - 1) <Insert manufacturer's name; product name or designation>.
 - d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].
 - 1) <Insert manufacturer's name; product name or designation>.
 - e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].
 - 1) <Insert manufacturer's name; product name or designation>.

f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

5. ~~Alkyd System [MPI INT 6.2C]:~~

a. ~~Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Alkyd, interior, matching topcoat.~~

c. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. ~~Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

M. ~~Wood Substrates, Opaque:: [Wood trim] [Architectural woodwork] [Doors] [Windows] [and] [wood board paneling].~~

1. ~~Latex over Latex Primer System [MPI INT 6.3T]:~~

a. ~~Prime Coat: Primer, latex, for interior wood[, MPI #39].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Latex, interior, matching topcoat.~~

c. ~~Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. ~~Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

- g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].
- 1) — <Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
- 1) — <Insert manufacturer's name; product name or designation>.
2. — Latex over Alkyd Primer System [**MPI INT 6.3U**]:
- a. — Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
- 1) — <Insert manufacturer's name; product name or designation>.
- b. — Intermediate Coat: Latex, interior, matching topcoat.
- c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].
- 1) — <Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].
- 1) — <Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].
- 1) — <Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].
- 1) — <Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].
- 1) — <Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
- 1) — <Insert manufacturer's name; product name or designation>.
3. — Institutional Low Odor/VOC Latex System [**MPI INT 6.3V**]:
- a. — Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
- 1) — <Insert manufacturer's name; product name or designation>.
- b. — Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. — Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].
- 1) — <Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].
- 1) — <Insert manufacturer's name; product name or designation>.

e. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

g. ~~Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

h. ~~Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

4. ~~High-Performance Architectural Latex System [MPI INT 6.3A]:~~

a. ~~Prime Coat: Primer, latex, for interior wood[, MPI #39].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~

c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

5. ~~Water-Based Light Industrial Coating System [MPI INT 6.3P]:~~

a. ~~Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~

c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

6. ~~Water-Based Alkyd System [MPI INT 6.3BB]:~~

a. ~~Prime Coat: Primer, latex, for interior wood[, MPI #39].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Alkyd, water based, matching topcoat.~~

c. ~~Topcoat: Alkyd, water based, gloss (MPI Gloss Level 6-7)[, MPI #157].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

7. ~~Alkyd System [MPI INT 6.3B]:~~

a. ~~Prime Coat: Primer sealer, alkyd, interior~~[, MPI #45].

1) ~~<Insert manufacturer's name; product name or designation>~~.

b. ~~Intermediate Coat: Alkyd, interior, matching topcoat.~~

c. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)~~[, MPI #49].

1) ~~<Insert manufacturer's name; product name or designation>~~.

d. ~~Topcoat: Alkyd, interior (MPI Gloss Level 3)~~[, MPI #51] ~~where indicated.~~

1) ~~<Insert manufacturer's name; product name or designation>~~.

N. ~~Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)~~[, MPI #47] where indicated.

1) ~~<Insert manufacturer's name; product name or designation>~~.

b. ~~Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)~~[, MPI #48].

1) ~~<Insert manufacturer's name; product name or designation>~~.

Wood Substrates, Transparent:

Stain, sealer, varnish:

Stain: One coat of stain

Sealer Coat: One coat of sealer

Topcoat: Satin Varnish (MPI Gloss Level 4).

O. ~~Wood Substrates: [Wood paneling] [and] [casework].~~

1. ~~Latex over Latex Primer System [MPI INT 6.4R]:~~

a. ~~Prime Coat: Primer, latex, for interior wood~~[, MPI #39].

1) ~~<Insert manufacturer's name; product name or designation>~~.

b. ~~Intermediate Coat: Latex, interior, matching topcoat.~~

c. ~~Topcoat: Latex, interior, flat (MPI Gloss Level 1)~~[, MPI #53].

1) ~~<Insert manufacturer's name; product name or designation>~~.

d. ~~Topcoat: Latex, interior (MPI Gloss Level 2)~~[, MPI #44].

1) ~~<Insert manufacturer's name; product name or designation>~~.

e. ~~Topcoat: Latex, interior (MPI Gloss Level 3)~~[, MPI #52].

1) ~~<Insert manufacturer's name; product name or designation>~~.

- f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 - 1) — <Insert manufacturer's name; product name or designation>.
2. — Latex over Alkyd Sealer System [**MPI INT 6.4A**]:
- a. — Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].
 - 1) — <Insert manufacturer's name; product name or designation>.
 - h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 - 1) — <Insert manufacturer's name; product name or designation>.
3. — Institutional Low-Odor/VOC Latex System [**MPI INT 6.4T**]:
- a. — Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
 - 1) — <Insert manufacturer's name; product name or designation>.

- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].

1) <Insert manufacturer's name; product name or designation>.

- d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].

1) <Insert manufacturer's name; product name or designation>.

- e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].

1) <Insert manufacturer's name; product name or designation>.

- f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, **MPI #146**].

1) <Insert manufacturer's name; product name or designation>.

- g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, **MPI #147**].

1) <Insert manufacturer's name; product name or designation>.

- h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, **MPI #148**].

1) <Insert manufacturer's name; product name or designation>.

4. High-Performance Architectural Latex System [**MPI INT 6.4S**]:

- a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].

1) <Insert manufacturer's name; product name or designation>.

- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, **MPI #138**].

1) <Insert manufacturer's name; product name or designation>.

- d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
5. ~~Water-Based Light Industrial Coating System [MPI INT 6.4N]:~~
- a. ~~Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
6. ~~Alkyd System [MPI INT 6.4B]:~~
- a. ~~Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Alkyd, interior, matching topcoat.~~
 - c. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, **MPI #51**].

1) — <Insert manufacturer's name; product name or designation>.

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #47**].

1) — <Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, **MPI #48**].

1) — <Insert manufacturer's name; product name or designation>.

P. — Wood Substrates: Traffic surfaces, including [floors] [and] [stairs].

1. — Latex Porch & Floor Enamel System [**MPI INT 6.5G**]:

a. — Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].

1) — <Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Floor paint, latex, matching topcoat.

c. — Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3)[, **MPI #60**].

1) — <Insert manufacturer's name; product name or designation>.

2. — Alkyd Floor Enamel System [**MPI INT 6.5A**]:

a. — Prime Coat: Floor enamel, alkyd, matching topcoat.

b. — Intermediate Coat: Floor enamel, alkyd, matching topcoat.

c. — Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6)[, **MPI #27**].

1) — <Insert manufacturer's name; product name or designation>.

Q. — Wood Substrates: Wood shingles and shakes.

1. — Latex over Latex Primer System [**MPI INT 6.6F**]:

a. — Prime Coat: Primer, latex, for interior wood[, **MPI #39**].

1) — <Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, **MPI #53**].

- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
 - 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 2. — Latex over Alkyd Primer System [MPI INT 6.6A]:
 - a. — Prime Coat: Primer sealer, alkyd, interior[, MPI #45].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Latex, interior, matching topcoat.
 - c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
 - 1) —<Insert manufacturer's name; product name or designation>.

h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

1) — <Insert manufacturer's name; product name or designation>.

3. — Alkyd System [MPI INT 6.6B]:

a. — Prime Coat: Primer-sealer, alkyd, interior[, MPI #45].

1) — <Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Alkyd, interior, matching topcoat.

c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].

1) — <Insert manufacturer's name; product name or designation>.

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].

1) — <Insert manufacturer's name; product name or designation>.

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) — <Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) — <Insert manufacturer's name; product name or designation>.

R. — Fiberglass Substrates:

1. — Latex System [MPI INT 6.7A]:

a. — Prime Coat: Primer, bonding, water based[, MPI #17].

1) — <Insert manufacturer's name; product name or designation>.

b. — Prime Coat: Primer, bonding, solvent based[, MPI #69].

1) — <Insert manufacturer's name; product name or designation>.

c. — Intermediate Coat: Latex, interior, matching topcoat.

d. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior (MPI Gloss Level 2)[, **MPI #44**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior (MPI Gloss Level 3)[, **MPI #52**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior (MPI Gloss Level 4)[, **MPI #43**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, **MPI #54**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- i. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 - 1) —<Insert manufacturer's name; product name or designation>.
- 2. — Institutional Low-Odor/VOC Latex System [**MPI INT 6.7J**]:
 - a. — Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - c. — Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - d. — Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].
 - 1) —<Insert manufacturer's name; product name or designation>.

- ~~g. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~h. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~i. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~3. High-Performance Architectural Latex System [MPI INT 6.7H]:~~
- ~~a. Prime Coat: Primer, bonding, water based[, MPI #17].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~b. Prime Coat: Primer, bonding, solvent based[, MPI #69].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~
- ~~d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~f. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~g. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
- ~~1) <Insert manufacturer's name; product name or designation>.~~
- ~~4. Water-Based Light Industrial Coating System [MPI INT 6.7C]:~~

- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - c. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, **MPI #151**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - e. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #153**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - f. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, **MPI #154**].
 - 1) <Insert manufacturer's name; product name or designation>.
5. Alkyd System [**MPI INT 6.7B**]:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - c. Intermediate Coat: Alkyd, interior, matching topcoat.
 - d. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, **MPI #49**].
 - 1) <Insert manufacturer's name; product name or designation>.
 - e. Topcoat: Alkyd, interior (MPI Gloss Level 3)[, **MPI #51**].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) —<Insert manufacturer's name; product name or designation>.

g. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) —<Insert manufacturer's name; product name or designation>.

S. — Plastic Substrates:

1. — Latex System [MPI INT 6.8E]:

a. — Prime Coat: Primer, bonding, solvent based[, MPI #69].

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

1) —<Insert manufacturer's name; product name or designation>.

g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].

1) —<Insert manufacturer's name; product name or designation>.

h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

1) —<Insert manufacturer's name; product name or designation>.

2. — Institutional Low-Odor/VOC Latex System [MPI INT 6.8F]:

a. — Prime Coat: Primer, bonding, solvent based[, MPI #69].

1) —<Insert manufacturer's name; product name or designation>.

- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, **MPI #143**].

1) <Insert manufacturer's name; product name or designation>.

- d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, **MPI #144**].

1) <Insert manufacturer's name; product name or designation>.

- e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, **MPI #145**].

1) <Insert manufacturer's name; product name or designation>.

- f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, **MPI #146**].

1) <Insert manufacturer's name; product name or designation>.

- g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, **MPI #147**].

1) <Insert manufacturer's name; product name or designation>.

- h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, **MPI #148**].

1) <Insert manufacturer's name; product name or designation>.

3. High-Performance Architectural Latex System [**MPI INT 6.8A**]:

- a. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].

1) <Insert manufacturer's name; product name or designation>.

- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, **MPI #138**].

1) <Insert manufacturer's name; product name or designation>.

- d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
4. ~~Water-Based Light Industrial Coating System [MPI INT 6.8C]:~~
- a. ~~Prime Coat: Primer, bonding, solvent based[, MPI #69].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, MPI #151].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, MPI #153].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, MPI #154].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
5. ~~Alkyd System [MPI INT 6.8B]:~~
- a. ~~Prime Coat: Primer, bonding, solvent based[, MPI #69].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Alkyd, interior, matching topcoat.~~
 - c. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].~~

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) —<Insert manufacturer's name; product name or designation>.

T. — Spray-Textured Ceiling Substrates:

1. — Latex, Flat System [MPI INT 9.1A]: Spray applied.

a. — Prime Coat: Latex, interior, flat, matching topcoat.

b. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

2. — Latex System [MPI INT 9.1E]: Spray applied.

a. — Prime Coat: Latex, interior, matching topcoat.

b. — Intermediate Coat: Latex, interior, matching topcoat.

c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

1) —<Insert manufacturer's name; product name or designation>.

g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].

1) —<Insert manufacturer's name; product name or designation>.

h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

1) — <Insert manufacturer's name; product name or designation>.

3. — Latex over Alkyd Sealer System [MPI INT 9.1B]:

a. — Prime Coat: Primer sealer, alkyd, interior[, MPI #45].

1) — <Insert manufacturer's name; product name or designation>.

b. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) — <Insert manufacturer's name; product name or designation>.

c. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) — <Insert manufacturer's name; product name or designation>.

d. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].

1) — <Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

1) — <Insert manufacturer's name; product name or designation>.

f. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].

1) — <Insert manufacturer's name; product name or designation>.

g. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].

1) — <Insert manufacturer's name; product name or designation>.

4. — Alkyd, Flat System [MPI INT 9.1C]:

a. — Prime Coat: Alkyd, interior, flat matching topcoat.

b. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].

1) — <Insert manufacturer's name; product name or designation>.

5. — Alkyd over Alkyd Sealer System [MPI INT 9.1D]:

a. — Prime Coat: Primer sealer, alkyd, interior[, MPI #45].

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Alkyd, interior, matching topcoat.

c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) —<Insert manufacturer's name; product name or designation>.

U.D. — [Gypsum Board] [**and**] [**Plaster**] Substrates:

1. Latex over Latex Sealer System [MPI INT 9.2A]:

a. Prime Coat: Primer sealer, latex, interior[, MPI #50].

1) —<Insert manufacturer's name; product name or designation>.

b. Prime Coat: Latex, interior, matching topcoat.

c. Intermediate Coat: Latex, interior, matching topcoat.

d. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) —<Insert manufacturer's name; product name or designation>.

f.d. — Topcoat: Latex, interior Egg Shell (MPI Gloss Level 3)[, MPI #52], (where indicated.)

1) —<Insert manufacturer's name; product name or designation>.

g.e. — Topcoat: Latex, interior Satin (MPI Gloss Level 4)[, MPI #43], (where indicated.)

1) —<Insert manufacturer's name; product name or designation>.

- h. ~~Topcoat: Latex, interior, Ssemi-gloss (MPI Gloss Level 5)[, MPI #54 (where indicated.)]-~~
- f. ~~<Insert manufacturer's name; product name or designation>.~~
- 2. ~~Epoxy over Epoxy Sealer System (Toilet, Soiled, Clean and Ante Rooms, where indicated):~~
 - a. ~~Prime Coat: Low VOC Waterbased Epoxy Primer~~
 - b. ~~Intermediate Coat: Pro Industrial High Performance Epoxy Intermediate Coat~~
 - c. ~~Top Coat: Pro Industrial High Performance Epoxy, Satin (where indicated) Top Coat.~~
 - 4)d. ~~Top Coat: Pro Industrial High Performance Epoxy, Semi-gloss (where indicated).~~
 - i. ~~Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
- 2. ~~Latex over Alkyd Primer System (for Plaster Only) [MPI INT 9.2K]:~~
 - a. ~~Prime Coat: Primer sealer, alkyd, interior[, MPI #45].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Latex, interior, matching topcoat.~~
 - c. ~~Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - g. ~~Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - h. ~~Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~

- 1) ~~<Insert manufacturer's name; product name or designation>.~~
3. ~~Institutional Low-Odor/VOC Latex System [MPI INT 9.2M]:~~
 - a. ~~Prime Coat: Primer sealer, interior, institutional low odor/VOC[, MPI #149].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~
 - c. ~~Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - g. ~~Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - h. ~~Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
4. ~~High-Performance Architectural Latex System [MPI INT 9.2B]:~~
 - a. ~~Prime Coat: Primer sealer, latex, interior[, MPI #50].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~

- b. ~~Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.~~
 - c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, **MPI #138**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, **MPI #139**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, **MPI #140**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - f. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, **MPI #141**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
5. ~~Water-Based Light Industrial Coating System [MPI INT 9.2L]:~~
- a. ~~Prime Coat: Primer sealer, latex, interior[, **MPI #50**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - b. ~~Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.~~
 - c. ~~Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[, **MPI #151**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - d. ~~Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #153**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
 - e. ~~Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[, **MPI #154**].~~
 - 1) ~~<Insert manufacturer's name; product name or designation>.~~
6. ~~Alkyd over Latex Sealer System [MPI INT 9.2C]:~~
- a. ~~Prime Coat: Primer sealer, latex, interior[, **MPI #50**].~~

1) —<Insert manufacturer's name; product name or designation>.

b. — Intermediate Coat: Alkyd, interior, matching topcoat.

c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) —<Insert manufacturer's name; product name or designation>.

f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) —<Insert manufacturer's name; product name or designation>.

V. — Acoustic Panels and Tiles:

1. — Latex, Flat System [MPI INT 9.3A]:

a. — Prime Coat: Latex, interior, matching topcoat.

b. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

2. — Latex over Alkyd Sealer System [MPI INT 9.3B]:

a. — Prime Coat: Primer sealer, alkyd, interior[, MPI #45].

1) —<Insert manufacturer's name; product name or designation>.

b. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) —<Insert manufacturer's name; product name or designation>.

c. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

1) —<Insert manufacturer's name; product name or designation>.

d. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].

1) —<Insert manufacturer's name; product name or designation>.

e. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].

- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
- 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].
- 1) —<Insert manufacturer's name; product name or designation>.
3. — Institutional Low-Odor/VOC Latex System [MPI INT 9.3D]:
- a. — Prime Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- b. — Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].
- 1) —<Insert manufacturer's name; product name or designation>.
- c. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].
- 1) —<Insert manufacturer's name; product name or designation>.
- d. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].
- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].
- 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].
- 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].
- 1) —<Insert manufacturer's name; product name or designation>.
4. — High-Performance Architectural Latex System [MPI INT 9.3E]:
- a. — Prime Coat: Latex, interior, high performance architectural, matching topcoat.
- b. — Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, MPI #138].
- 1) —<Insert manufacturer's name; product name or designation>.

c. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[, MPI #139].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[, MPI #140].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[, MPI #141].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

5. ~~Alkyd, Flat System [MPI INT 9.3C]:~~

a. ~~Prime Coat: Alkyd, interior, matching topcoat.~~

b. ~~Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

W. ~~[Cotton or Canvas] [and] [ASJ] Insulation-Covering Substrates: Including [pipe and duct coverings] <Insert description>.~~

1. ~~Latex System [MPI INT 10.1A]:~~

a. ~~Prime Coat: Primer sealer, latex, interior[, MPI #50].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

b. ~~Intermediate Coat: Latex, interior, matching topcoat.~~

c. ~~Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

d. ~~Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

e. ~~Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

f. ~~Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

g. ~~Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].~~

- 1) ~~— <Insert manufacturer's name; product name or designation>.~~
- h. ~~— Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].~~
- 1) ~~— <Insert manufacturer's name; product name or designation>.~~
2. ~~— Institutional Low-Odor/VOC Latex System [MPI INT 10.1D]:~~
 - a. ~~— Prime Coat: Primer sealer, latex, interior[, MPI #50].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
 - b. ~~— Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.~~
 - c. ~~— Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[, MPI #143].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
 - d. ~~— Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[, MPI #144].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
 - e. ~~— Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[, MPI #145].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
 - f. ~~— Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[, MPI #146].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
 - g. ~~— Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[, MPI #147].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
 - h. ~~— Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[, MPI #148].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~
3. ~~— Alkyd System [MPI INT 10.1B]:~~
 - a. ~~— Prime Coat: Primer sealer, latex, interior[, MPI #50].~~
 - 1) ~~— <Insert manufacturer's name; product name or designation>.~~

- b. — Intermediate Coat: Alkyd, interior, matching topcoat.
- c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].

1) — <Insert manufacturer's name; product name or designation>.

- d. — Topcoat: Alkyd, interior, (MPI Gloss Level 3)[, MPI #51].

1) — <Insert manufacturer's name; product name or designation>.

- e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].

1) — <Insert manufacturer's name; product name or designation>.

- f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

1) — <Insert manufacturer's name; product name or designation>.

4. — Aluminum Paint System [MPI INT 10.1C]:

- a. — Prime Coat: Primer sealer, latex, interior[, MPI #50].

1) — <Insert manufacturer's name; product name or designation>.

- b. — Intermediate Coat: Aluminum paint matching topcoat.

- c. — Topcoat: Aluminum paint[, MPI #1].

1) — <Insert manufacturer's name; product name or designation>.

X. — Bituminous-Coated Substrates:

1. — Latex System [MPI INT 10.2A]:

- a. — Prime Coat: Primer, rust-inhibitive, water based[, MPI #107].

1) — <Insert manufacturer's name; product name or designation>.

- b. — Intermediate Coat: Latex, interior, matching topcoat.

- c. — Topcoat: Latex, interior, flat (MPI Gloss Level 1)[, MPI #53].

1) — <Insert manufacturer's name; product name or designation>.

- d. — Topcoat: Latex, interior (MPI Gloss Level 2)[, MPI #44].

- 1) —<Insert manufacturer's name; product name or designation>.
- e. — Topcoat: Latex, interior (MPI Gloss Level 3)[, MPI #52].
 - 1) —<Insert manufacturer's name; product name or designation>.
- f. — Topcoat: Latex, interior (MPI Gloss Level 4)[, MPI #43].
 - 1) —<Insert manufacturer's name; product name or designation>.
- g. — Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[, MPI #54].
 - 1) —<Insert manufacturer's name; product name or designation>.
- h. — Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, MPI #114].
 - 1) —<Insert manufacturer's name; product name or designation>.
2. — Alkyd System [MPI INT 10.2B]:
 - a. — Prime Coat: Primer, rust inhibitive, water based[, MPI #107].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - b. — Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. — Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[, MPI #49].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - d. — Topcoat: Alkyd, interior (MPI Gloss Level 3)[, MPI #51].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - e. — Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[, MPI #47].
 - 1) —<Insert manufacturer's name; product name or designation>.
 - f. — Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].
 - 1) —<Insert manufacturer's name; product name or designation>.
3. — Aluminum Paint System [MPI INT 10.2C]:
 - a. — Prime Coat: Primer, rust inhibitive, water based[, MPI #107].
 - 1) —<Insert manufacturer's name; product name or designation>.

- b. ~~Intermediate Coat: Aluminum paint, matching topcoat.~~
- c. ~~Topcoat: Aluminum paint[, MPI #1].~~

1) ~~<Insert manufacturer's name; product name or designation>.~~

END OF SECTION 099123

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.
2. Impact-resistant wall coverings.
3. Stainless steel corner guards.

B. Related Sections:

1. Division 9 Section "Gypsum board assemblies and Non-structural metal framing" for metal blocking for surface-mounted wall guards, corner guards, and handrails.
2. Division 6 Section "Premium Interior Architectural Woodwork" for cherry wood, solid surface materials and stainless steel strips shown on some wall protection bumper and handrails.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. applied in any direction.
2. Concentrated load of 200 lbf applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.

1. Include similar Samples of accent strips and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Wall and Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
 2. Handrails: 12 inches long. Include examples of joinery, corners, and field splices.
 3. Impact-Resistant Wall Covering: 6 by 6 inches square.
 4. Door-Surface Protection: 6 by 6 inches square.
 5. Door and -Frame Protectors: 12 inches long.
 6. Door-Knob and -Lever Protectors: Full-size unit of each type.
- E. Qualification Data: For qualified Installer.
- F. Material Certificates: For each impact-resistant plastic material, from manufacturer.
- G. Material Test Reports: For each impact-resistant plastic material.
- H. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.
- I. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- F. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units 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 sheet material out of direct sunlight.
 - 3. Store plastic wall 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 and handrail covers in a horizontal position.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall 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.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.
 - 1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
 - 2. Chemical and Stain Resistance: Tested according to ASTM D 543 , ASTM D 1308.
 - 3. Self-extinguishing when tested according to ASTM D 635.
 - 4. Flame-Spread Index: 25 or less.
 - 5. Smoke-Developed Index: 450 or less.

- B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
- C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 for Alloy 6063-T5.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M.
- E. Solid Wood: Clear hardwood lumber of species indicated, free of appearance defects, and selected for compatible grain and color. (Wood used in wall protection specified in division 06 Premium interior architectural woodwork section).
- F. 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.
- G. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 MANUFACTURERS

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product specified or comparable product by the following: (This product is presently used in the building).
 - a. Korogard Wall Protection Systems; a division of RJF International Corporation.

2.3 WALL GUARDS

- A. Bumper-Rail-Type Wall Guards: Provided under Section 064030 - Premium Interior Architectural Millwork.
- A. Chair-Rail-Type Wall Guards: Provided under Section 064030 - Premium Interior Architectural Millwork.

2.4 CORNER GUARDS

- A. Surface-Mounted, Resilient Plastic Corner Guards: Surface-mounted, resilient plastic corner-guard assembly consisting of a snap-on-type plastic cover installed over a continuous aluminum retainer, height as indicated.
 - 1. Cover: Extruded, rigid plastic, minimum 0.078 inch thick, in dimensions and profiles indicated.
 - a. Corner Radius: 1/4 inch.
 - 2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.062 inch thick.
 - 3. Accessories: Provide prefabricated, injection-molded top cap and aluminum base with concealed splices, cushions, mounting hardware, and other accessories as required.

- a. Top caps shall match color of plastic covers and shall be field adjustable for close alignment with snap-on plastic covers.
- B. Surface-Mounted, Opaque-Plastic Corner Guards: Fabricated as one piece from PVC-free plastic acrylic-modified vinyl sheet or opaque polycarbonate sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
 1. Mounting: Adhesive.
 2. Color and Texture: As indicated in Finish Schedule on Drawings. .
- C. Stainless steel corner guards.
 1. Stainless steel .06 inches thick minimum x 2 inches in width from center corner. Provide radius corners at top.
 2. Finish: 304 brushed stainless steel.

2.5 WALL PROTECTION PANELS

- A. Manufacturer: Koroguard.
- B. Thickness: Sheet panels, .060 inch thickness . Refer to finish plans and schedule for locations.
- C. Color and Texture: As indicated in Finish Schedule on Drawings.

2.6 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Preform curved semirigid, impact-resistant sheet wall covering in factory for radius and sheet thickness as follows:
 1. Sheet Thickness of 0.060 Inch: 36-inch radius.
- C. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- D. Fabricate components with tight seams and joints 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.
- E. Miter corners and ends of wood handrails for returns.

2.7 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Remove tool and die marks and stretch lines, or blend into finish.
 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 3. Run grain of directional finishes with long dimension of each piece.

4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall 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 impact-resistant wall protection units attached with adhesive or foam tape, 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 impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units 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.
1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated below: See interior elevations for wall protection heights above finish floor for Crash Rails, Bumper Rails, Rub Rails, Chair Rails and Handrails.
 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. 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.
 - c. Adjust end and top caps as required to ensure tight seams.

- B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

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 12 3553 - LABORATORY CASEWORK

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 the work of this section.

1.2 WORK INCLUDED

- A. Furnishing of materials, products, accessories, tools, equipment, services, scaffolding, ladders, transportation, supervision, labor, product protection, and other items that may not be specifically mentioned, but are necessary for the fabrication and installation of laboratory casework.
- B. Furnish and install laboratory casework including, but not limited to, work surfaces, adjustable shelves, tables, standards, slotted studs, filler panels, scribes, knee space panels, accessories, casework in environmental rooms, utility space framing, utility space closure panels between base cabinets and at exposed ends of utility spaces, laboratory sinks, cup sinks, cup drains, strainers, overflows and sink outlets with integral or separate pieces, and miscellaneous items of equipment as listed in these specifications and as shown on drawings, including delivery to the building, unpacking, installing, leveling and scribing to walls and floors as required.
- C. Furnish and deliver packed in boxes for receipt, handling and installation by others; electrical service fixtures, task lights including fluorescent bulbs, electrical receptacles and switches listed in these specifications and as shown on drawings as part of the laboratory casework. The above-defined items are to be supplied, not attached, and loose in boxes, properly marked for tailgate delivery.
- D. Furnish and set in place for final installation and connection by other trades; service fittings where part of the laboratory casework, listed in the specifications or shown on drawings. Tailpieces shall be furnished less couplings required to connect to the trap or drain piping system. Install service fittings "finger-tight".
- E. Furnish and mount plumbing and electrical fixtures on fume hood superstructure.

1.3 RELATED WORK BY OTHER SPECIFICATION SECTIONS

- A. Furnishing, installation and connection of "Service Lines" within and/or attached to equipment, slotted studs, partitions, service tunnels or service turrets, through, under or along backs of working surfaces as required for "Service Fixtures."
- B. Final installation, tightening and connecting "Service Fixtures" furnished by laboratory casework manufacturer including the pulling of wire and connecting of electrical fixtures in service lines.
- C. Receiving, handling, installing and connecting separate laboratory sinks, cup sinks or drains, overflows, sink outlets and tail-pieces furnished by the laboratory casework manufacturer.

- D. Furnishing, installing and connecting vents and drain lines.
- E. Furnishing, installing, setting and connecting special electrical and plumbing fixtures and piping to meet local codes, even though not specifically called for in specifications and shown on drawings.
- F. Furnishing, installing and connecting of ducts from fume hoods to blowers and from blowers to atmosphere.
- G. Furnishing, handling and installing fans with motors (blowers).
- H. Furnishing, and installation of framing or reinforcements for wall, floors and ceilings to adequately support laboratory equipment and brick, plaster, metal or wood grounds required for proper anchoring of the equipment.
- I. Furnishing and installation of pipe hangers.
- J. Furnishing and installation of resilient base on walls and fixed laboratory casework after laboratory casework installation is completed.
- K. Furnishing in-wall exhaust duct and connection to vented cabinets.
- L. Related Sections include the following:
 - 1. Division 1 Section "LEED Requirements" for additional LEED requirements.
 - 2. Division 6 Section "Rough Carpentry" for wood blocking for anchoring casework.
 - 3. Division 6 Section "Interior Architectural Woodwork".
 - 4. Division 9 Section "Gypsum Plaster" for reinforcements in metal- framed plaster partitions for anchoring casework.
 - 5. Division 9 Section "Gypsum Wallboard Assemblies" for reinforcements in gypsum board partitions for anchoring casework.
 - 6. Division 9 Section "Resilient Wall Base and Accessories" for resilient base applied to casework.
 - 7. Division 11 Section "Laboratory Fume Hoods"
 - 8. Division 22 and 26 Sections for installing service fittings specified in this section.
 - 9. Divisions 22 and 26 for connecting service utilities at indicated points. Piping and wiring for service fittings within casework up to point of connection are specified in this Section.
- M. CASEWORK SYSTEM: Laboratory casework components and assemblies shall meet local seismic restraint requirements including, but not limited to, the following:

1.4 DEFINITIONS

- A. "Add-A-Drawer" refers to a generic system of laboratory casework; it does not refer to a particular brand or manufacturer.
- B. "Laboratory Casework Contractor" is defined as the manufacturer and/or manufacturer's representative furnishing and installing the laboratory casework, equipment, and accessories listed under these specifications, laboratory equipment schedule and/or shown on drawings.
- C. "Service Fixtures" are defined as gas, air, and vacuum, hot, cold, reagent grade water faucets, remote control valves, electrical receptacles with necessary flush mounting boxes, conduits or pedestals and plates, fluorescent and/or incandescent light fixtures, light switches and/or motor switches for hoods and other items which serve as a functional part of the equipment.
- D. "Service Lines" are defined as gas, air, vacuum, hot, cold, reagent grade and reference grade water piping, drain lines, fittings and shut off valves necessary to carry respective services from building roughing-in floors or walls through equipment to "service fixture".
- E. "Service Lines" also include conduit, junction boxes, conduit fitting, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to "service fixtures."
- F. "Standards" are wall mounted, twin-tracked shelf supports.
- G. "Slotted Studs" are double-faced, twin-tracked studs comprising the frame spanning between the utility chase and the building wall or workstation at peninsula bench assemblies.
- H. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. This also includes tops and bottoms of shelving in open or glass doored units and open wall shelving.
- I. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semi-exposed.
- J. Concealed Portions of Cabinets: Surfaces nor usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.5 STANDARDS

- A. REFERENCE Scientific Equipment & Furniture Association (SEFA)
 - 1. SEFA 1 Laboratory Fume Hoods
 - 2. SEFA 2.3 Scientific Laboratory Furniture And Equipment
 - 3. SEFA 7 Laboratory and Hospital Fixtures

4. SEFA 8 Laboratory Furniture-Casework-Shelving and Tables – Recommended Practices.
- B. American Society for Testing and Materials (ASTM)
1. A240-Heat Resistant Chromium and Chromium – Nickel Stainless Steel Plate, Sheet, and Strip for pressure Vessels
 2. A312-Seamless and Welded Austenitic Stainless Steel Pipe
 3. D260-Boiled Linseed Oil
 4. D570-Water Adsorption of Plastics
 5. D695-Compressive Properties of Rigid Plastics
 6. D790-Fluctural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
 7. E84-Test Method for Surface Burning Characteristics of Building Materials
- C. Builders Hardware Manufacturers Association (BHMA)
- D. National Electrical Manufacturers Association (NEMA)
- E. American National Standards Institute (ANSI) A208.1-Wood Products
- F. American National Standards Institute (ANSI) A135.4-Basic Hardboard
- G. American National Standards Institute (ANSI) HPVA HP-1-2000 American National Standard for Hardwood and Decorative Plywood.
- H. American Plywood Association (APA) Engineered Wood Association
- I. National Particleboard Association (NPA) 8-Voluntary Standard for Formaldehyde Emission form Particleboard
- J. United States Department of Commerce, Product Standard (PS) 1-Construction and Industrial Plywood
- K. United States Department of Commerce, Product Standard (PS) 51-Hardwood and Decorative Plywood
- L. National Fire Protection Association (NFPA) 30 Flammable Liquid Storage
- M. National Fire Protection Association (NFPA) 70 Electrical Components, Devices and Accessories.
- N. Architectural Woodwork Institute (AWI) Quality Standards, Guide Specifications, and Quality Certification Program, 8th Edition, version 1.0, 2003.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An authorized representative of the casework manufacturer for installation and maintenance of units required for this Project.
- B. **Source limitations:** Though products may be manufactured by different manufacturers, obtain and install all casework, including work surfaces, sinks, service fittings and accessories, and fume hoods through one source from a single Laboratory Furniture Contractor.
- C. **Movable Laboratory Bench Systems** must be Underwriters Laboratories (UL) 61010A-1 approved and listed. Other UL listings may be acceptable as long as the electrical requirements as shown on the drawings are satisfied. UL label shall be attached to the product.
- D. **Electrical components, Devices and Accessories:** Listed and labeled as define in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- E. **Pre-installation Conference:** Conduct a conference at the Project Site to comply with requirements in Division 1 Section "Project Management and Coordination.
- F. **Product Standard:** Comply with SEFA 8, "Laboratory Furniture-Casework, Shelving and Tables-Recommended Practices".

1.7 SUBMITTALS

- A. Refer to submittal section of the General and Supplementary Specification in Division 1 for requirements and procedures. Fabrication or purchase of any items prior to approval will be at the manufacturer's risk.
- B. **Samples:** Laboratory casework manufacturer shall submit the following samples for approval by the Owner's Representative, prior to fabrication of the specified mock-up:
 - 1. One (1) 24 inch (600mm) wide full height base cabinet consisting of one (1) drawer, one (1) door, one (1) cupboard with adjustable half/full depth shelf and related hardware (pulls, hinges, etc.), complete with finish.
 - 2. One 36 inch wide by 36 inch high (900mm wide by 900mm high) wall cabinet with two internal adjustable shelves as well as related hardware and doors, complete with finish.
 - 3. One (1) 24 inch (600mm) long standard, and one (1) end bracket, with specified finish.
 - 4. **Service Fixtures:** one of each fixture type required for project.
 - 5. **Adhesives and sealants.**
 - 6. **Work surface material (one of each specified):** 12 inches by 12 inches by 1 inch (300mm x 300mm x 25mm) thick, showing top, front edge and backsplash construction.

- C. Reviewed samples will be retained by the Owner's Representative.
- D. Stain and Finish Samples for Wood Components
 - 1. Stain for casework and miscellaneous items, shall be selected by the Owner's Representative. The laboratory casework manufacturer shall furnish stain and finish samples on same material from which the casework and miscellaneous items will be constructed for approval before fabrication of casework starts. Samples shall be clearly identified.
 - 2. Stain and finish samples will be retained by the Owner's Representative.
- E. Shop Drawings. Fabrication or purchase of any equipment prior to approval will be at the manufacturer's own risk. The laboratory casework manufacturer shall furnish shop drawings showing enclosures, cabinets, hardware, and service banks complete with numbers and names of items and details including construction kinds and gages of materials for hood, cabinets, benches and other items necessary to complete the work. In addition, it is the responsibility of the casework manufacturer to flag any deviations in dimension, material, detail, etc. that is not exactly the same as shown on the contract documents. Those deviations not flagged will be considered "not reviewed", even if missed during the approval process and will have to be changed. Provide number of copies of drawings and data sheets in accordance with Division 1 requirements.
- F. Shop drawings shall be stamped and signed by a registered engineer for conformance to structural and lateral requirements. Stamped and signed calculations shall also be provided.
- G. Non-Structural Lateral Force Design: Submit detailed seismic anchorage and attachment drawings and calculations furnished by a Utah-licensed Structural Engineer. The submittal shall include:
 - 1. Dimensions and location of the center of gravity of the component.
 - 2. Weight assumed in the calculations including contents.
 - 3. Specification of anchorage to concrete in detail, including inspection and testing requirements, if any (inspection and testing to be furnished under this section, if required).
 - 4. Reaction loads to the supporting structure or other component.
 - 5. If a component other than the structure is used for seismic support, the submittal shall show the adequacy of the load path to the structure or otherwise demonstrate compliance with limitations in the contract documents.

The submittal will be reviewed by the design professional responsible for this section of the specification to confirm that it is responsive to project specific context and criteria. The adequacy of the primary structure to resist the reaction loads imparted on the primary structure shall be reviewed and approved by the project Structural Engineer.

1.8 MOCK-UP

- A. Laboratory casework manufacturer shall erect a laboratory casework mock-up at the location as indicated on the Drawings. Once selected, the assembly shall be constructed and assembled in accordance with the construction documents. Modifications required to meet this specification shall be incorporated into the overall design of the project without change in contract sum. Mockup shall include ALL laboratory casework components including fume hoods, fixtures and casework to represent a completed laboratory module. Utilities and hoods do not have to be operable.
- B. Once installed and approved. The mock-up shall be maintained at the project site during construction as a standard for judging the completed work.

1.9 EXCEPTIONS TO DRAWINGS AND SPECIFICATION

- A. All exceptions shall be subject to written approval prior to receipt of bid. If no written communication is received prior to receipt of bid and approval indicated in an addendum, it is assumed that bidder will be in total compliance with specifications and will be held responsible for default or delay, regardless of any statement to the contrary in their written proposal.
- B. Requests for a substitution must be made directly to the Owner's Representative's office for consideration no later than fifteen (15) working days prior to bid receipt date.
- C. Requests for a substitution following the bid opening will be rejected.
- D. Substitutions approved prior to bid date will be handled as an addendum and be sent to all bidders.

1.10 WARRANTY

- A. Furnish a written warranty that Work performed under this Section shall remain free from defects as to materials and workmanship for a period of one (1) year from date of acceptance. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner. Defects include, but are not limited to:
 - 1. Ruptured, cracked, or stained coating
 - 2. Discoloration or lack of finish integrity
 - 3. Cracking or peeling of finish
 - 4. Delamination of components or edge banding
 - 5. Slippage, shift, or failure of attachment to wall, floor, or ceiling

6. Weld or structural failure (visible weld marks)
7. Warping or unloaded deflection of components
8. Failure of hardware

1.11 TESTING

- A. The laboratory casework manufacturer shall be required to include in their initial submittals, certified test reports indicating compliance of their laboratory casework finish and work surface materials with requirements specified for chemical and physical resistance; and confirmation of load performance for movable tables. The material test reports shall be performed by an independent testing agency qualified for testing indicated, as documented according to ASTM E548.

1.12 FIELD MEASUREMENTS

- A. It is the laboratory casework manufacturer's responsibility to verify field measurements and that equipment will fit through entryways, corridors and door openings enabling a smooth flow of equipment to its proper location in the building.

1.13 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver casework only after painting, utility rough-ins and similar operations that could damage, soil or deteriorate casework have been completed in installation areas.
- B. Storage: If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article of this specification section.
- C. Handling: Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.14 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework 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 casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating the casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.15 COORDINATION

- A. Coordinate layout of metal framing and reinforcements in wall assemblies for support of the casework.
- B. Coordinate installation of casework with installation of fume hoods and other laboratory equipment including rough-in locations and requirements.

1.16 EXTRA MATERIALS

- A. Furnish complete touch-up kit for each type and finish of the casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damages casework finish.
- B. Furnish extra materials described in Part 3 that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.17 CERTIFIED WOOD PRODUCTS

- A. Wood products used in the fabrication of all wood components shall comply with the Forest Stewardship Council (FSC) "Percentage Based Claims Policy Green Rating System" and shall bear the Forest Conservation Program Label. Wood/fiber products shall come from FSC "certified" sustained managed forestry sources, complying with FSC 1.2, Principals and Criteria. Manufacturer shall submit documentation that the source of at least 70% of the wood/fiber material used in its products are certified for sustainability contents. A "chain-of- custody" certificate must be submitted at time of bid. Certificate shall provide a system for tracking certified wood from the forest, through each stage of production and distribution, to the point of sale. Certificates shall be by U.S. Based certifiers, Scientific Certification Systems, Emeryville, California, Woodmark or SmartWood.
- B. Wood products shall utilize an environmentally friendly, low VOC (under 2 lbs. Per gallon). Finish process, stains and finishes, shall be executed with the use of compression spray equipment capable of providing high-transfer efficiency and low waste generation. Finish material shall meet SEFA 8 chemical testing requirements.
- C. Adhesive manufacturer's product data sheets are to be provided indicating that the adhesive does not contain urea formaldehyde.
- D. All plywood cores are required to have no added urea formaldehyde. This means all veneer cores and/or cross banded panels must use PVA glue lines and all composite core binders must be formaldehyde free.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wood Casework: Subject to compliance with requirements, provide products by one of the following:

1. CiF Lab Solutions
Vaughn, Ontario, Canada L4K 3T2
(905) 738-5821
www.cifcolutions.com
2. Mid Canada Millwork
Steinbach, Manitoba, Canada R5G 1X8
(204) 326-5888
www.midcanadamillwork.com
3. OCRiver Laboratory Furniture
Suring, Wisconsin
(877) 348-9663
www.ocriver.com

B. Metal Casework: Subject to compliance, provide products by one of the following:

1. Bedcolab
Laval, Quebec, Canada H7S 1N5
(800) 461-6414
www.bedcolab.com
2. Kewaunee Scientific Corporation
Statesville, North Carolina 28677
(704) 873-7202
www.kewaunee.com
3. Mott Manufacturing
Brantford, Ontario, Canada N3T 5L8
(519) 752-7825
www.mott.ca
4. Jamestown Metal Products
Jamestown, New York 14701
(716) 665-5313
www.jamestown.com
5. Hamilton Scientific
De Pere, WI 54115
920-793-1121
www.hamiltonscientific.com

C. Epoxy Resin Work Surfaces and Sinks: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Durcon Corporation (Taylor, TX)
2. Epoxyn Products (Mountain Home, AR)
3. Kewaunee (Statesville, NC)

D. Phenolic Resin

1. Trespa North America, Ltd.
2. Durcon Corporation
3. Arborite: Division of Premark Canada Inc.
4. H.T.C. Incorporated
5. Panolam Surface Systems; Pionite Decorative Surfaces

E. Phenolic Resin Casework

1. NuLab Furniture Corporation
2. Caseworx, Inc.
3. Or approved equal.

F. Chemical-Resistant Plastic Laminates:

1. Arborite; Division of Premark Canada Inc.
2. Formica Corporation.
3. International Paper; Decorative Products Division.
4. Panolam Surface Systems; Pionite Decorative Surfaces.
5. Wilsonart International.

G. The naming of a manufacturer and designation of a product is for the purpose of identifying a basis of design. Other manufacturers capable of producing the same appearance and having the same quality, durability, and performance may be proposed for use on this project subject to approval of the Owner's Representative, prior to the receipt of bid.

H. Qualified Bidders must submit with their bid evidence of the successful completion of at least five (5) projects using laboratory casework systems and furniture of the type specified for this project.

2.2 CASEWORK RELATED MATERIALS

A. Stainless Steel:

1. Work surfaces, sinks, stainless steel accessories, shelves and shelf supports noted on drawings as "Stainless Steel" shall be type 302/304, austenitic chromium nickel stainless steel in accordance with A.I.S.I. specification containing 8% nickel and 18% chromium. Where noted as such, stainless steel components and shelf supports shall be constructed

- exactly as those fabricated of cold rolled sheet steel and the same gages. Exposed surfaces shall have #4 finish.
2. Work surfaces and sinks noted on drawings as "Type 316 Stainless Steel" shall be similar to type 302/304 except molybdenum is added to improve the general corrosion and pitting resistance.
- B. Clear Float Glass: Complying with ASTM C 1036, Type I, Class 1, Quality q3 not less than 3.0mm thick.
- C. Clear Tempered Glass: Complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3, not less than 3.0mm thick.
- D. Clear Laminated Safety Glass: Complying with ASTM C1172, Kind LT, Condition A, Type 1, Class 1 with 2 lites not less than 3.0mm thick with clear, polyvinyl butyl interlayer.
- E. Solid Hardwood: AWI Grade I, solid hardwoods shall be properly air-dried, then kiln dried to 5% to 6% moisture content, and then tempered in inside storage to moisture content of 6% to 8%. Wood used in interior construction to match exterior in species, finish and grade. All semi and semi concealed areas to also use Grade I lumber.
- F. Core:
1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
 2. Particle Core Plywood: ANSI A208.1-1999, Grade M-3-Exterior Glue, 45 lb (20.4kg) banded on vertical edge of the hinge side with 1-1/2 inch (38.1mm) solid hardwood. Doors shall be cross-banded with veneer then apply 1/42 inch -1/50 inch (.9mm) face veneer. If particle board is used for cabinet construction then cabinet side where doors hinge must also be constructed with 1-1/2 inch solid wood stile to receive hinges.
- G. Edge-banding for Wood-Veneered Construction: Minimum 5/32 inch (4 mm) thick, eased solid wood of same species as face veneer. Ease edge 1/32 inch maximum. No roll or tape type edge banding will be acceptable.
- H. Plywood. Plywood shall be veneer core construction glued with water resistant resin adhesives. Hardwood plywood for exposed surfaces shall have face veneers of selected hardwood species and shall conform to ANSI/HPVA HP1 product standards, latest edition. Plywood for interior and unexposed surfaces shall be hardwood plywood conforming to U.S. Department of Commerce Voluntary Product Standard PS-1.
- I. Particleboard. Particleboard to be used with plastic laminate work surfaces and shelves shall be of 45lb. (20.4 kg.) density, and balanced construction with moisture content not to exceed 8%. Particleboards shall meet or exceed the requirements of ANSI A208.1-1999. Particleboard shall meet the following performance requirements. Submit compliance data from the manufacturer prior to fabrication:
1. Screw-holding, Face 247 lbs.
 2. Screw-holding Edge 225 lbs.

- | | | |
|----|-----------------------|-------------|
| 3. | Modulus of Rupture | 2,393 psi. |
| 4. | Modulus of Elasticity | 398,900 psi |
| 5. | Internal Bond | 80psi. |
| 6. | Surface Hardness | 500 lbs. |

J. Hardboard. Hardboard shall meet or exceed ANSI/AHA A135.4-1995 Un-tempered hardboard 1/4 inch (6.35mm), S1S, nominal thickness, smooth exposed side.

K. Exposed Materials:

1. General: Provide materials that are selected and arranged for uniformity of grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings. No water stains, no sharp contrasts at veneer joints will be accepted.
2. Wood Species and Veneer Cut: Sap Maple, plain sliced
 - a. Stain Colors and Finishes: As selected by the Owner's Representative from manufacturer's full range.
 - b. Solid Wood: Clear hardwood lumber.
 - c. Plywood: Hardwood plywood; Grade AA exposed faces at least 1/50 inch (0.5 mm) thick, solid cross-bands. Backs of same species as faces; Grade A.

L. Semi-exposed Materials:

1. Plywood: Hardwood plywood of same species as exposed plywood. Grade A faces, Grade J cross-bands.

M. Concealed Materials:

1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood. Grade 1, Concealed backs of plywood with exposed or semi-exposed faces shall be same species as faces.

N. Veneer, grain and color shall be as follows:

1. Exposed surfaces: Grade AA with vertical grain on fronts of cabinets including doors and drawers.
 - a. Sides and backs to be Grade A with vertical grain.
2. Semi-Exposed surfaces, sides and backs of cabinets: Grade A vertical grain.
3. Concealed Surfaces: Grade 1
4. Door and drawer heads, including Add-A-Drawer units, within the same cabinet shall be cut and vertically matched from the same sheet of veneer

and be book matched, centered and balanced across the cabinet width. Sink cabinets or other cabinets with a single piece apron across the front shall also have veneers that are vertically aligned book matched, centered and balanced across the cabinet width. Cabinet fronts shall be cut from the same sheet of veneer. For fixed casework, veneers shall be sequence matched across the entire elevation.

5. Grain direction on bottoms and tops of base, wall and tall cabinets and on shelves shall run lengthwise.

O. Epoxy Resin

1. Physical Properties:
 - a. Compressive Strength (ASTM D695): 38,400 psi (265,000 kPa)
 - b. Flexural Strength (ASTM D790): 14,900 psi (103,000 kPa)
 - c. Tensile Strength (ASTM D638): 14,000 psi (96,500 kPa)
 - d. Hardness (Rockwell M): Not less than 110
 - e. Heat Distortion (ASTM D648): 325 degrees Fahrenheit (163 degrees Celsius)
 - f. Water Absorption (ASTM D570): 0.008 %
 - g. Fire Resistance (ASTM D635): Self Extinguishing
2. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

- P. Phenolic Resin: Phenolic Resin board material shall consist of layers of phenolic impregnated kraft papers that are compressed in a flat press at pressures exceeding 100 psi (685.9 kPa) and at 300 deg. F (149 deg. C). The top surface layer shall contain the required color pigmentation. The material shall meet the following requirements:

1. Density: 85.9 lb/cu.ft. (1374 kg/m³)
2. Surface Hardness: 85-95 Rockwell D Scale
3. Flexural Strength (ASTM D-790): 22,000 PSI Machine Direction
4. Abrasion Resistance (NEMA LD3-3.01): 1400 Cycles
5. Flame Spread Index-Surface Buring (ASTM E-84-UL723): 30
6. Flame Spread Index-Radiant Heat Source (ASTM E-162): 17
7. Chemical Resistance: Composite work surfaces material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

- a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, formaldehyde (37 percent), furfural, hydrochloric acid (37 percent), hydrofluoric acid (48 percent), nitric acid (30 percent), phosphoric acid (85 percent), sodium hydroxide (20 percent), sulfuric acid (33 percent), toluene, and zinc chloride.
- Q. Polycarbonate Resin Sheets: Lexan as manufactured by General Electric Corporation, or Tuffak as manufactured by Rohm and Hass Company. Clear sheets free of warp and distortion.
- R. Polypropylene: Provide sheets smooth, free of surface blemishes, low flame spread and low smoke generating type.

2.3 WORK SURFACES AND CURBS

- A. General: Laboratory work surfaces shall be 1 inch thick epoxy resin unless otherwise noted. Curbs shall be 3/4 inch thick of the same material as the work surfaces and shall be provided at the rear of work surfaces and on end returns. Epoxy and stainless steel work surfaces to be installed without field cutting or drilling. The gap between the curb and wall is to be sealed with silicone sealant, color matched to the work surfaces. Sink work surfaces shall be fabricated in one piece and have a marine edge around the four sides to create a dished top. Provide work surfaces in maximum lengths as possible to minimize seams. Provide front and end overhang of 1 inch (25mm), with continuous drip groove on underside 1/2 inch (13mm) from edge.
- B. Epoxy Resin Work Surfaces: Epoxy resin work surfaces, curbs, service ledges and perimeter service ledges shall be molded from a modified epoxy resin especially compounded and cured to give optimum physical and chemical resistant properties. Material shall be a uniform mixture throughout the full thickness. Materials shall have a non-specular finish in gray color. Curbs shall typically be 4 inch (100mm) high, unless otherwise noted on Drawings, and shall be 3/4 inch (19mm) thick bonded to the surface of the top using epoxy adhesive to form a square joint. Epoxy resin work surfaces shall be 1 inch (25mm) thick except in fume hoods where they will be 1-1/4 inch (32 mm) thick. Joints between work surfaces shall be smooth, even, square, 1/8 inch (3mm) wide maximum.
- 1. Work Surface Fabrication: Fabricate with factory cutouts for sinks and with butt joints assembled with epoxy adhesive.
 - a. Work Surface Configuration: Flat, 1 inch (25mm) thick, with beveled top, front edge and all corners, with drip groove. Ends shall be square.
- C. Stainless Steel Work Surfaces: Work surfaces and curbs noted on drawings as "Stainless Steel", Type 316 Stainless steel shall be constructed of 16 gage (1.6mm) nominal thickness, stainless steel sheet, ASTM A666. Exposed surfaces shall have #4 satin finish.
- 1. Extend top down 1 inch (25mm) at edges with a 1/2 inch (13mm) return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
 - 2. Form curb coved to and integral with top surface of one piece, without seams or joints. The top of the curb shall be chamfered 45 degrees.

3. Provide raised (marine) edge around perimeter of work surface containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.
4. Reinforce underside of work surface with channels where necessary to insure rigidity without deflection and coat with a sound deadening material where not exposed to view.
5. Work surfaces shall be as long as practical to permit access to the building and room. Where field-made joints are required, provide continuous channels welded to the underside of the work surface for reinforcing and aligning the butt-joints.
6. Electrically weld shop and field made joints, and grind and polish surfaces to produce uniform, directionally textured finish, free of cross scratches. When polishing is completed rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
7. Where stainless steel sinks or cup sinks occur in stainless-steel work surfaces, factory weld into one integral unit, grind welds smooth, polish and rinse. Work surfaces shall be adequately reinforced to accept sinks.

D. Plastic-Laminate:

1. Plastic-Laminate Shelves: Plastic-laminate sheet complying with NEMA LD 3, shop bonded with waterproof adhesive to both sides. Use 3/4 inch hardwood plywood for core if 30 inch long or less; use 1 inch thick hardwood plywood for shelves longer than 30 inches with 1/8 inch (4 mm) eased hardwood edging on front of fixed shelves within cabinets and all four edges of adjustable shelves. Sand surfaces to which plastic laminate is to be bonded. Top and bottom surfaces shall be laminated with matching laminate.
2. Chemical-Resistant Plastic Laminate: Provide product for shelves that complies with grade specified above and has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), amyl acetate, benzene, butyl alcohol, carbon tetrachloride, chloroform, dimethyl formamide, dioxane, ethyl acetate, ethyl alcohol, ethyl ether, formaldehyde (37 percent), gasoline, gentian violet, [hydrochloric acid (37 percent),] hydrogen peroxide (3 percent), methyl alcohol, methyl ethyl ketone, methylene chloride, [methyl red,] mono chlorobenzene, naphthalene, [nitric acid (30 percent),] [phenol (90 percent),] [phosphoric acid (75 percent),] [silver nitrate (saturated),] [sodium hydroxide (20 percent),] [sulfuric acid (77 percent),] toluene, trichloroethylene, xylene, and zinc chloride (saturated).
 - b. Slight Effect: Cresol, [methyl red,] [phenol (90 percent),] [sodium hydroxide (20 percent),] sodium sulfide (15 percent), and tincture of iodine.

- c. Moderate Effect: [Hydrochloric acid (37 percent)] [nitric acid (30 percent)] [phosphoric acid (75 percent)] [silver nitrate (saturated)] [and] [sulfuric acid (77 percent)].

2.4 ADJUSTABLE SHELVES

- A. Wood Shelves: 1 inch 9 ply veneer core plywood with 5/32 inch (4mm) thick hardwood [square] [eased] edge banding on all four edges. Grain is to run along the longest dimension of the shelf. Particle board is not acceptable for shelving.
 - 1. Adjustable wood shelves mounted on slotted studs shall be supplied with a continuous 3/4 inch (20 mm) thick, 2 inch (50 mm) high hardwood edge band to create a 1 inch (25 mm) high curb at the rear of the shelf. The hardwood edge banding along the back shall be replaced by this wood curb. Particle board is not acceptable for shelving.
- B. Adjustable phenolic resin shelves mounted on standards shall be 3/4" thick phenolic resin.
- C. Adjustable shelves shall be 15 inch or 18 inch deep, unless otherwise noted on the Drawings.
- D. Adjustable shelves shall be mounted to surface type steel standards at wall condition and slotted studs at movable tables and island bench conditions. Adjustable shelves shall be supported by steel shelf brackets not to exceed 48 inches on center. Brackets shall be cold rolled steel with epoxy powder coated finish, complying with BHMA A156.9, Types B04102 and B04112. Shelves shall be fastened to brackets with two stainless steel screws per bracket.
- E. Adjustable shelves mounted on slotted studs shall be supplied with edge-banding on all four sides with a continuous 2 inch (50mm) high band to create a 1 inch (25mm) high curb at the rear of the shelf. The curb along the back shall be of solid hardwood to match cabinet material.
- F. Exterior adjustable shelves, those not in cabinets, shall be equipped with a 1/4 inch (6 mm) diameter, 2 inch (50 mm) high anodized aluminum rail at the front of the shelf. Rail lengths shall not exceed 36 inch (914mm) in nominal length (provide tow 24 inch (610 mm) long nominal rails for 48 inch (1219 mm) shelves). Rails shall be fastened to the shelf in a similar manner as wire pulls are fastened to drawers and doors. Stainless steel screws to be accessible from underside of shelf. Press fit rails are acceptable.
- G. Stainless-Steel Shelves: Made not less than 0.050-inch (1.3mm) nominal thickness. Fold down front edge 3/4 inch (19mm); fold up back edge 3 inches (75mm). Provide integral stiffening brackets, formed by folding up ends 3/4 inch (19mm) and welding to upturned back edge. Weld shop made joints, grind smooth and polish.

2.5 CABINET DESIGN

- A. Casework shall be fabricated as sectional units, ready for placement in the laboratory as a complete integral rigid unit permitting relocation at any subsequent time. Equivalent to AWI Section 400 Wood Cabinets, Premium grade. Component parts of the unit shall be manufactured ensuring uniformity, interchangeability and accurate alignment. No staples will

be permitted as fasteners on any cabinet components. All base cabinets to have integral enclosed bases.

- B. Where noted as such, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly must be capable of supporting an equipment load of at least 150 lb. (68.04kg) per running foot (304.8mm) above and beyond the weight of the assembly.
- C. Sides of all sectional units shall be considered exposed and shall be finished accordingly.

2.6 CABINET CONSTRUCTION

- A. Cabinet construction shall meet AWI, Flush Overlay requirements and specifically meet the following tolerances:
 - 1. The gap between doors, drawers and pull out boards shall be consistently straight and not exceed 1/8 inch (3 mm). The top edge of drawers must be no more than 1/8 inch below the top panel of movable cabinets.
 - 2. The vertical gap between door, drawer head and pull out boards and the gap between adjacent cabinets shall not exceed 1/8 inch (3 mm). This criteria will require the doors, drawer heads and pull out boards be no further than 1/16 inch (1.5 mm) from the exterior vertical edge of the cabinet.
- B. To achieve these tolerances, the hinge must be mortised into the door side. Wall cabinets with hinged doors shall meet the same gap tolerances as base cabinets. Hinges must also be cut into door edge band to achieve required tolerances.
- C. Sectional units to be located on the laboratory floor shall be equipped with adjustable leveling devices.
- D. Adjustable Shelves located in cabinets shall be edge banded on all four edges of each shelf component.
- E. Fixed shelves located in cabinets shall be edge banded on front edge of each shelf component.
- F. Dark Room Cabinets: Cabinets located in darkrooms, with the exception of those located under sink units shall be equipped with light tight doors and drawers. They shall match the cabinets located in adjacent rooms in material, finish and construction details.
- G. Whenever a cabinet is adjacent to a partition, the laboratory casework contractor will install a minimum 1 inch filler panel to accommodate the over face design and avoid potential interference from partition erection tolerances.
- H. Units, except cabinets with glides, shall have backs with removable panels for access to the pipe spaces at the rear of the units. Removable panels shall be provided in sides of units where units occur in the corners of the rooms and access is required to the pipe spaces. These removable panels shall be designed to permit removal utilizing only a screwdriver through the fronts of the units and no intermediate rails between drawers are required.

1. Ends of Cabinets: 3/4 inch (19mm) 7 ply veneer core plywood with front exposed edges faced with a 1/8 inch (3mm) solid hardwood with edges chamfered 1/32 inch. End panels shall be glued to horizontal frame units and to solid bottom panels. Joint construction shall be blind, not extended to face of cases. Joinery shall be blind mortise and tenon, multiple doweled, interlocking mechanical or stopped tongue and groove.
2. Tops and bottoms of Wall Cabinets and tops of Tall Cabinets: 1 inch (25mm) thick 9-ply veneer core plywood with exposed edge faced with 1/8 inch (3mm) solid hardwood.
3. Fixed Backs of Movable Cabinets: 3/4 inch (19mm) thick 7 ply veneer faced plywood where exposed, doweled and rabbeted into end panels.
4. Backs on Stationary Cabinets: 1/4 inch thick veneer core plywood dadoed into sides, bottoms, and tops where not exposed. Removable backs shall be removable from inside the cabinet with a minimal use of tools. Provide 1 inch x 1inch cleats, top, bottom and sides, at the rear corners of the cabinet to fasten the removable panel.
5. Wall Mounted Cabinet Bottoms: 1 inch (25 mm) thick 9-ply veneer core plywood with exposed edge faced with 5/32 inch (4 mm) solid hardwood.
6. Shelves: 1 inch (25 mm) thick 9-ply veneer core plywood with exposed edge faced with 5/32 inch (4 mm) solid hardwood. The shelves shall be full depth adjustable type.
7. Drawer Fronts: 3/4 inch (19mm) thick particleboard with hardwood faced veneers, edge banded with 5/16 inch (4 mm) solid hardwood. Drawer fronts shall be fastened to the drawer bodies with screws.
8. Drawer Bottoms: 1/4 inch (6mm) thick PVC-coated hardboard glued and dadoed into front, back, and sides of drawers. Use 1/2 inch (12.7mm) thick material for drawers more than 24 inches (600 mm) wide or add center support in drawer.
9. All corners of cabinet box, doors, drawers and shelves shall be chamfered not greater than 1/32 inch. Radiused corners are not acceptable.
10. Doors 48 Inches (1200 mm) or Less in Height: 3/4 inch thick, with particleboard cores, solid hardwood stiles and rails, and hardwood face veneers and cross-bands. Doors shall have 1-1/2 inch solid hardwood stile at hinge side.
11. Stiles and Rails of Glazed Doors: 3/4-inch- (19-mm-) thick solid hardwood. Sawing pattern on stiles and rails shall match the veneer cut of panel products. Joints shall be mortice and tenon.

2.7 ADD-A-DRAWER BASE CABINETS

- A. Add-A-Drawer Base Cabinets: Cabinets with non-marring leveling glides or otherwise noted must incorporate "Add-A-Drawer" design to allow casework to be used in both standing and sitting height configuration and shall be constructed as follows:
1. Base cabinet shall be nominally 27 inches high. The top of the base cabinet shall be plastic laminate (color selected by the Owner's Representative) with 3/4 (19mm) wide x 5/32 inch (4 mm) thick edge banding on four sides. Base cabinets shall have a finished 12 gage metal plate across the full bottom face of the cabinet through which non-marring leveling glides shall be attached. Interior bolt heads for leveling glides shall be countersunk.
 2. Where noted on the drawings, cabinets with non-marring leveling glides shall be constructed with toe spaces. The cabinet shall be constructed with a reinforced base capable of supporting a 4 inch (100mm) high non-marring leveling glide assembly in each corner. Leveling glides shall be rated for minimum 250 pounds (113.4 KG) load each. The entire assembly shall be reinforced to permit mobility without twisting and achieve an industry standard height of 30 inch or 37 inch (725 mm or 925 mm) including the flush 1 inch (25 mm) work surface. Leveling glides shall be through-bolted through bottom of cabinet at all four bolts and interior bolt heads shall be countersunk to conceal bolt heads. Allow sufficient clearance between top of cabinet and underside of work surfaces or apron to facilitate movement. Cabinets with non-marring leveling glides shall be completely finished including 4mm edge banding on four sides, top and bottom as all surfaces are considered exposed. Cabinets shall have a minimum 45 lbs. counterweight in the rear of the cabinet to help prevent tip over of the cabinet.
 3. A 7 inch (150 mm) high, fully enclosed drawer box made same width as cabinet below, shall sit on top of each base cabinet to create a standing height cabinet. Top of the apron shall be plastic laminate (color selected by the Owner's Representative) with 3/4 inch (19mm) wide x 5/32 inch (4 mm) thick edge banding on four sides.
 4. Apron shall be aligned with two (2) threaded zinc pins that engage cabinet's top rail through pre-drilled holes with full diameter threaded zinc metal inserts. In addition (1) camlock mechanism (Hafele #261059902/993/984) shall be located at the rear of the base cabinet to lock the add-a-drawer apron to the cabinet. No exceptions to this product will be allowed.
 5. Table height, to top of work surface, shall be set at either 30 inch or 37 inch to allow a refrigerator to be installed below. The table shall have a 2 inch solid apron front and 7 inch solid apron on sides and back.
 6. Drawer units must be equipped with a drawer interlock mechanism so that only one drawer in a vertical stack can be opened at one time. Interlock unit shall be integral part of the drawer slide unit equal to Acuride Model 3641 and companion slide Model 3642. Drawer units shall have a

minimum 45 lbs. counterweight in the rear of the unit to help prevent tip over of the cabinet.

2.8 WALL MOUNTED CASEWORK

- A. Where noted on drawings, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly's construction however, must be modified to withstand the rigors of being mounted directly to the wall and suspended above the floor, without sagging or effecting the door or drawer operation. The assembly must be capable of supporting an equipment load of at least 150 lb. (68.04kg) per running foot (304.8mm) above and beyond the weight of the assembly.

2.9 WOOD FINISH:

- A. Preparation: Exposed surfaces to receive finish shall be free of machine marks, carefully and smoothly sanded, prior to assembly, in preparation for finishing. Sand edges of doors, drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling for uniform smoothness at least equivalent to that produced by 600 grit sanding.
- B. Staining: Remove fibers and dust before applying stain to exposed and semi-exposed surfaces as necessary to match approved samples. Apply stain in a manner that will produce a consistent appearance.
 - 1. Exposed and semi exposed surfaces shall be first coated with a stain or toner to secure the desired color. The color coat shall be thoroughly dried. Wood finish shall consist of two coats of a chemical resistant finish applied and thoroughly dried and cured providing a semi-gloss finish. When a natural finish is required, the color coat is omitted. Stain shall be as selected by the Owner's Representative.
 - 2. Concealed Surfaces shall receive a double pass coat of resinous sealer.
- C. Chemical Resistant Finish: Apply chemical resistant, transparent finish consisting of sealer and topcoat(s) complying with AWI TR-5 and SEFA chemical testing requirements. Finish shall be individually applied, sanded and allowed to individually dry. Top frames of drawer openings and toe spaces shall be sealed with clear sealer.
- D. Chemical Resistance Testing Criteria: Finish shall comply with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance levels for chemical spot test shall be no more than four Level 3 conditions and as follows: Level 0: no detectable change; Level 1: slight change in color; Level 2: Slight surface etching or severe staining; Level 3: Pitting, cratering, swelling or erosion of coating. Obvious and significant deterioration when tested in the following method
 - 1. Method A Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-oz. Bottle and inverting the bottle on the surface of the panel.
 - 2. Method B Test non-volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.

a.	Acetate Acids: Amyl and Ethyl	A
b.	Acetic Acid: 98%	B
c.	Acetone	A
d.	Acid Dichromate, 5%	B
e.	Alcohols: Butyl, Ethyl or Methyl	A
f.	Ammonium Hydroxide, 28%	B
g.	Benzene	A
h.	Carbon Tetrachloride	A
i.	Chloroform	A
j.	Chromic Acid: 60%	B
k.	Cresol	A
l.	Dichlor Acetic Acid	A
m.	Dimethylformamide	A
n.	Dioxane	A
o.	Ethyl Ether	A
p.	Formaldehyde, 37%	A
q.	Formic Acid: 90%	B
r.	Furfural	A
s.	Gasoline	A
t.	Hydrochloric Acid: 37%	B
u.	Hydrofluoric Acid: 48%	B
v.	Hydrogen Peroxide: 3%	B
w.	Iodine, Tincture of	B
x.	Methyl Ethyl Ketone	A
y.	Methylene Chloride	A
z.	Mono Chlorobenzene	A
aa.	Naphthalene	A
bb.	Nitric Acid: 20%	B
cc.	Nitric Acid: 30%	B
dd.	Nitric Acid: 70%	B
ee.	Phenol, 90%	A
ff.	Phosphoric Acid 85%	B
gg.	Silver Nitrate, Saturated	B
hh.	Sodium Hydroxide: 10%, 20% or 40%	B
ii.	Sodium Hydroxide, Flake	B
jj.	Sodium Sulfide, Saturated	B
kk.	Sulfuric Acid: 33%	B
ll.	Sulfuric Acid: 77%	B
mm.	Sulfuric Acid: 96%	B
nn.	Sulfuric Acid: 77% and Nitric Acid 70%	B
oo.	Toluene	A
pp.	Trichloroethylene	A
qq.	Xylene	A
rr.	Zinc Chloride, Saturated	B
E.	Hot Water Test: SEFA 8; Hot water (190 degree F. to 205 degree F. (88Degree C. to 96 degree C.) shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces (177.44cc) per minute) on the finished surface, which shall be set at an angle of 45 degrees, for a period of five minutes. After cooling, and wiping dry, the finish shall show no visible effect from the hot water.	
F.	Impact Resistance Test: There shall be no visual evidence to the naked eye of cracks or checks in the finish due to impact when an 2 inch (50 mm) diameter, one pound ball is	

dropped onto the finished surface from a height of 12 inch (305 mm) onto a flat horizontal surface, in accordance with testing as described in SEFA 8.

2.10 PHENOLIC RESIN CASEWORK REQUIREMENTS

- A. Entire cabinet shall be constructed of solid composite panels with black core.
- B. Construction and design to develop maximum strength and rigidity in each sectional unit. Each sectional unit to be completely fabricated ready for placement in the laboratory casework and equipment assembly. Each cabinet to be a complete integral rigid unit within itself to permit relocation at any subsequent time.
- C. Cabinets shall be of mortise and tenon construction resulting in a premium style flush overlay unit. Casework shall be rigid and self-supporting, capable of interchangeable use in assembly or as a stand-alone cabinet. All vertical and horizontal members shall be keyed in, then phenol seal bonded and mechanically fastened. All exposed edges shall be sanded and polished to a satin smooth finish. Underside and toe space shall be enclosed and vermin proof. Base cabinet backs shall be removable.
- D. The cabinet shall incorporate full overlay design in which case body is concealed behind the doors and drawer fronts. The door and drawer fronts shall create a 1/8" horizontal reveal. There shall be a 1/8" vertical reveal at the edge of each cabinet creating a 1/4" vertical reveal at the end of each cabinet when two cabinets are set in place next to each other.
- E. All interior material is to be white. Doors, drawer fronts, toe kick, applied finished end panels and fillers are to be a standard stock color.
- F. Each cabinet's vertical and horizontal members shall be mechanically fastened. Exposed edges on cabinet components to be machined polished black core. Exposed edges on door and drawer fronts to be machined with a 3/4" radius to form a bull-nosed edge detail. Corners of doors and drawer fronts shall be radiused 1/8".
- G. Component Thickness Schedule:
 - 1. Cabinet sides and bottoms: 0.5" min. (12.7mm)
 - 2. Door and drawer fronts: 0.5" min. (12.7mm)
 - 3. Horizontal rails: 0.5" min. (25.4mm)
 - 4. Cabinet backs: 0.25" min. (3.18mm)
 - 5. Cabinet shelves: 0.5" min. (19mm)
 - 6. Security Panels: 0.5" min. (12.7mm)
 - 7. Drawer Box: 0.375" min. (10mm)

8. Drawer bottoms: 0.25" min. (3.18mm)
- H. Drawer and Door units:
1. Each base cabinet shall consist of drawers or doors or a combination hereof as shown in drawings.
 2. All base cabinets, unless specified in drawings otherwise, shall have removable back panels from the inside of the cabinet for access to the pipe spaces to the rear of the cabinet as available in the cabinet design. Drawer bank cabinets to have split removable backs.
 3. Door units to be provided with a shelf adjustable on 1-1/4" (32mm) centers. Shelf clips to engage shelf in such a way as to avoid slippage and horizontal movement of shelf.
 4. Sectional units shall have 4" (101.6mm) high by 3" (76.2mm) deep toe space members unless otherwise noted on drawings.
 5. Drawers shall be full box construction, fabricated of 3/8" thick solid composite phenolic resin material. Drawer bottoms shall be matching 1/4" material.
- I. Wall and tall storage cabinets shall match in design and construction (per sectional units as specified previously).
- J. Glass for glazed doors: nominal 1/8" (3.18mm) thick tempered clear safety glass with visible safety logo unless otherwise specified.
- K. Framed glass doors: Identical in construction, hardware and installations to solid panel doors. Frame glass doors to be removable for glass replacement utilizing a clear retainer clip.
- L. All construction fasteners shall be zinc plated or stainless steel.
- M. Solid composite materials shall be warranted against delamination for 10 years.
- N. Hardware:
1. Hinges to be heavy duty, brushed 304 stainless steel, five-knuckle Hospital-tip, fixed pin, and all edges eased. Each hinge to have a minimum of seven screw attachment holes. Hinges to accommodate 1/2" door thickness.
 2. Hinge Quantity: One pair per door to 48" height; one and one half pair per door 48" through 80" height; two pair per door over 80" height. Hinge to allow for 270 degrees of swing.
 3. Pull Quantity: Drawers under 24" in width to receive one pull. Drawers over 24" in width to receive two pulls. All doors to receive one pull.

4. Drawer suspension: Mechanical slides shall be full extension, 100lb. dynamic, zinc plated Accuride 3832 series (or approved equal), for all drawers including pull-out boards
5. Catches: Nylon roller with nylon base and stops.
6. Adjustable shelf supports: Shelf clips to be single pin metal and will engage shelf in such a way as to avoid slippage and movement of shelf.

O. Color:

1. Doors, drawers, finished fronts, finished end panels, toe kicks, bottoms of wall cabinets, filler strips and other exposed surfaces to be selected by University's representative from Manufacturer's standard color pallet.

2.11 SOURCE QUALITY CONTROL TESTING OF EPOXY RESIN WORK SURFACE

- A. Test procedure: Apply 5 drops of each reagent to surface and cover with 25 mm watch glass, convex side down; test volatiles using 1 ounce (28 ml) bottle stuffed with saturated cotton. After 24 hour exposure flush surface, clean, rinse and wipe dry.
- B. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

- C. Test Results: Submit a report of the test results. The results shall be equal to or better than the following:

	<u>REAGENT</u>	<u>RATING</u>
1.	Hydrochloric Acid, 37 %	Excellent
2.	Sulfuric Acid, 33 %	No Effect
3.	Sulfuric Acid, 77 %	No Effect
4.	Sulfuric Acid, 96 %	Failure
5.	Formic Acid, 90 %	Excellent
6.	Nitric Acid, 20 %	Excellent
7.	Nitric Acid, 30 %	Excellent

8.	Nitric Acid, 70 %	Good
9.	Hydrofluoric Acid, 48	Fair
10.	Phosphoric Acid, 85 %	No Effect
11.	Chromic Acid, 60 %	Failure
12.	Acetic Acid, 98 %	Excellent
13.	3 & 8 Equal Parts	Excellent
14.	Ammonium Hydroxide, 28 %	No Effect
15.	Sodium Hydroxide, 10 %	No Effect
16.	Sodium Hydroxide, 20 %	No Effect
17.	Sodium Hydroxide, 40 %	No Effect
18.	Sodium Hydroxide Flake	No Effect
19.	Sodium Sulfide	Excellent
20.	Zinc Chloride	No Effect
21.	Tincture of Iodine	Excellent
22.	Silver Nitrate	No Effect
23.	Methyl Alcohol	No Effect
24.	Ethyl Alcohol	No Effect
25.	Butyl Alcohol	No Effect
26.	Benzene	Excellent
27.	Xylene	No Effect
28.	Toluene	Excellent
29.	Gasoline	No Effect
30.	Dichloroacetic Acid	Good
31.	Dimethylformamide	Excellent
32.	Ethyl Acetate	No Effect
33.	Amyl Acetate	Excellent
34.	Acetone	Excellent
35.	Chloroform	Excellent
36.	Carbon Tetrachloride	No Effect
37.	Phenol	Excellent
38.	Cresol	Excellent
39.	Formaldehyde	No Effect
40.	Trichlorethylene	Excellent
41.	Ethyl Ether	Excellent
42.	Furfural	Good
43.	Methylene Chloride	Excellent
44.	Monochlorobenzene	Good
45.	Dioxane	Excellent
46.	Methylethyl Ketone	Excellent
47.	Acid Dichromate	Fair
48.	Hydrogen Peroxide	No Effect
49.	Naphthalene	Excellent

2.12 MOVEABLE TABLES:

- A. Movable tables shall be constructed as indicated on the Drawings.

- B. Movable tables shall have a 1-1/2 inch apron front and 7 inch apron on sides and back. It shall have 2 inch outside diameter painted steel tube and 1-3/4 inch inner painted steel telescoping leg.
- C. Levelers: 1-1/2 inch round – 16 NC x 2-1/2" inch long levelers with non-marring floor glides at each leg complete with locking nut.
- D. Moveable tables shall have the ability to be adjusted in height from 30 inches to 37 inches in 1 inch increments inclusive of 1 inch thick work surface.
- E. Movable tables shall be installed at height indicated on Drawings. Fixed metal section of leg shall be set at height appropriate for a 30 inch high table top. Coordinate the under-counter clearance with casework and refrigerators.
- F. Movable tables shall be reinforced with a deep welded steel channel frame and corner brackets appropriate for the load bearing requirements and concealed by wood elements. Load capacity of tables shall be 1,000 lb. (453.6kg) uniformly loaded and support a 250 lb. (113.4kg) concentrated load at mid-space with deflection not to exceed 1/8 inch (3 mm).
- G. Movable table shall be equipped with an epoxy work surface unless otherwise noted.

2.13 MOVEABLE LABORATORY BENCH SYSTEM

A. General

- 1. Work surface support frame: 11 gage cold rolled steel
- 2. Finish: Chemical resistant epoxy or urethane powder paint finish in custom color selected by the Owner's Representative.
- 3. Table height, to top of work surface, shall be set at either 30 inch or 37 inch to allow a refrigerator to be installed below. The table shall have a 4 inch solid apron on sides and back. Table shall be adjustable in 1 inch increments.

B. Work Surface Table Frame:

- 1. Nominal table frame dimensions:
 - a. Widths and Depths as indicated on the drawings
 - b. Adjustable Height: 30 inch to 37 inch AFF including 1 inch thick work surface.
- 2. Front upright member are 2 inch outside diameter tube and 1-1/2 inch inner telescoping leg steel tubing. Capable of vertical adjustment in one-inch increments. Fasteners to be stainless steel pan head screws.
- 3. Levelers : 1-1/2 inch round - 16 NC x 2-1/2 inch long levelers with non-marring floor glides at each leg complete with locking nut.
- 4. Rear corners shall have 2.25 inch diameter x 6 inch high 11-gage collar. Front half of the collar shall be welded to the work surface frame with

supporting gussets and the back half mechanically fastened to the rear uprights with socket head button cap and bolt.

5. Back stop angle, with full length bumper, shall be located under the work surface frame to position the 24 inch deep mobile base cabinet 1 inch behind the front edge of the work surface.
6. Load Rating: 100 lbs per linear foot of width to maximum of 800 lbs. With 800 lbs of uniformly distributed load applied to an 8 foot wide work surface, the maximum allowable deflection shall be 1/8 inch measured at the front center rail.

C. Rear Frame Support Structure

1. Nominal dimensions:
 - a. Width: As indicated on the drawings.
 - b. Height: 84 inches
2. Rear upright supports shall be 11 gage, 2 inches outside diameter.
3. Levelers: 1-1/2 inch round – 16 NC x 3.5 inch long, model # 23015T56 as distributed by McMaster-Carr Supply Company, New Brunswick, NJ, or equal.
4. All units over shall have a center support to accommodate split shelving. Back-to-back tables shall share a common center shelf support that acts as a conduit for piped services, electrical and data.
5. Uprights have slots punched on 1 inch increments starting at nominal 55 inch above the floor to the top of the upright.
6. Upper and lower horizontal cross rails shall be 11 gage steel.
7. Lower structural cross rail shall support an integral two-channel raceway.
8. Raceway to have two (2) 20 amp hospital grade duplex receptacles on 42 inch, 48 inch and 60 inch wide units, three (3) 20 amp hospital grade duplex receptacles on 72 inch wide units, and (1) 20 amp duplex receptacle located in the vertical upright under the work surface.
9. Provide GFI receptacles on all benches within 6' of water source.
10. Wiring to the 20 amp duplexes are in one upright with plumbing and data cables in the center upright support. Services shall be routed horizontally over to the center post in up-turned channel at the top of the frame.
11. Raceway shall have one data connection.

D. Plumbing Fixtures

1. Maximum of three plumbing services available.

2. Valves shall be as specified under Mechanical Service Fittings in this specification section and as scheduled on sheet QL0.02 in the drawings.
3. Plumbing lines shall be 0.25 inch OD x .035 inch wall thickness of 316 stainless steel tubing with quick disconnect attached to the tube with compression fittings at the top of the upright. Each half of the quick disconnect, coupler and nipple shall be valved.
4. The plumbing lines with the quick disconnects are to be arranged so services cannot be intermixed.

E. Electrical and Data Connections

1. Electrical power services shall have a 20-amp twist lock plug. The NEMA type for the plug shall be as specified in Division 26 and matches the receptacle configuration in the ceiling service panel. Provide an adequate cord length extending from the top of the upright to the ceiling service panel.
2. Data Cat 6 line will have a male plug extending 48 inch above the upright. Provide an adequate cord length extending from the top of the upright to the ceiling service panel.

F. Shelves

1. All shelf supports shall be powder coated cold rolled steel.
2. Shelves shall overhang 1 inch behind the face of the vertical tubular support.
3. Shelf brackets shall be 11-gage cold rolled powder coated steel.
4. Vertical shelf adjustment to be in 1 inch increments.
5. Load capacity shall be 30 lbs per linear foot.
6. Adjustable Shelving.
 - a. As described under article "Adjustable Shelving" within this section, unless modified under this Article.
 - b. Gap between back-to-back shelves must be no more than an 1/8 inch.
 - c. Shelf Retainers: Lower and middle shelves shall have a removable 18 gage, powder coated, cold rolled steel back rail which acts as a back stop and can be turned upside down to provide a flush work surface with units are placed back-to-back. Upper shelf to have a removable 18 gage steel back rail.

G. Task Lights

1. Task light shall be as specified under Electrical Fixtures in this specification section.

H. Service Line Assembly

1. Tubing: Fre-Thane 95A Durometer Polyurethane tubing as manufactured by Freelin-Wade Co. (McMinnville, Oregon) Tubing shall be 3/8 inch O.D. with a 1/4 inch I.D. rated for 170 psi working pressure. Provide a 316L stainless steel fitting both ends (3/8 inch O.D. compression to 1/4 inch MNPT). Tubing shall be [coil] [straight] type, [light gray] in color. Manufacturer to provide sleeve for tubing management.
2. Quick-Disconnect Couplers: Keyed, color coded, 316L stainless steel mechanical quick disconnect couplings (sockets and plugs) shall be used to connect between the Ceiling Service Panel and the Movable Table. Couplers shall connect only with properly keyed mate and be color-coded to identify different key combinations. Each half of the quick disconnect couplers (socket and plug) shall be valved. Socket keyed quick couplers subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following: Staubli (Duncan, South Carolina).

I. Four Leg Adjustable-Height Add-A-Leg Table

1. Nominal table frame dimensions:
 - a. Width and depth as indicated on the drawings.
 - b. Adjustable Height: 30 inch to 37 inch AFF including 1 inch thick work surface.
2. Work surface table frame shall be able to detach from the rear frame and form a four-leg adjustable height table with the addition of two Add-A-Legs.
3. Add-A-Leg member shall be the same construction and finish as the front upright member.

2.14 TABLE LIFT MECHANISM

- A. Provide one scissor-type lift carts, capable of raising movable tables off floor without marring finish in order to permit height adjustment. Unit shall be capable of operating a both sitting and standing height. Unit shall be fabricated of materials compatible with decontamination procedures involving the use of steam and para-formaldehyde application.
- B. Unit shall be equal to R.S. Material Handling, Inc, St. Catherine, Ontario, Canada (905.687.7176) catalog # BX50 or approved equal.

2.15 CEILING SERVICE PANELS:

- A. The Ceiling Service Panel (CSP) is a rigid mounting surface for laboratory utilities distributed along the centerline of a laboratory bench group. Panels are designed to accommodate standard junction boxes for electrical and data, as well as medical grade quick connect fittings for the distribution of specialty gases, compressed air, and vacuum. CSP is designed to fit

- most suspended t-bar grid ceiling systems and is specified in a 6 inch width. Panel lengths will be as noted on drawings.
- B. A CSP is used in conjunction with a steel frame laboratory table which is vertically adjustable. Utilities on the laboratory table connect to the CSP via cables incorporating twist-lock or flexible tubing with quick-disconnect fittings. Overhead utility supply from the CSP allows for flexibility and mobility of laboratory services without the need to penetrate floors and walls.
 - C. CSP shall be fabricated from 11-gage cold rolled steel with urethane or epoxy powder coated finish. All four edges of each panel shall be flanged to a depth of 3/4 inch. Flanges shall have a maximum 1/16 inch radius and shall be welded at intersecting corners to improve rigidity. Nominal panel width as indicated on drawings. Panel lengths will vary and are indicated on the Drawings. Height of the panel varies with the size of junction boxes and utility fittings attached. Panels shall be fabricated with openings and mounting holes for all junction boxes and utility fittings. Final finish shall be applied after all flanges, openings and holes are fabricated.
 - D. CSP will be detailed in the laboratory construction documents to include various combinations of utilities by group designation (CSP1, CSP2, etc...) to support a number of laboratory types and bench arrangements. All quick disconnect fittings, distribution tubing and gas hoses shall be supplied with the CSP by Division 12. Division 22 shall supply connections to vacuum at the CSP. Electrical receptacles, electrical cords, twist-lock plugs, data jacks, cables, communication wiring, faceplates and corresponding connections to those devices shall be supplied by Division 26.
 - E. Electrical receptacles shall be labeled with circuit number. Emergency power receptacles shall be red and labeled "EMERGENCY" in red lettering.
 - F. Laboratory casework components and assemblies shall meet local seismic restraint requirements including, but not limited to, the following:

2.16 HARDWARE AND ACCESSORIES

- A. General: Provide laboratory casework manufacturer's standard satin-finish, commercial grade quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Drawer, Door and Pull Out Board Pulls. Door and drawer pulls shall be 4 inch (101.6mm) wire type, stainless steel satin finish, fastened from the back with two screws. Drawer and pullout board pulls shall be installed horizontally, door pulls shall be installed vertically. Wall cabinet and floor storage cabinet pulls should be located for reaching convenience and ADA accessibility guidelines. Two pulls shall be required on all drawers over 24 inches wide.
- C. Rollers and Sheaves: Rollers and sheaves shall be cadmium plated hardened steel or nylon, specifically designed for their application. Sliding door sheaves shall have a special contour for engagement with the one-piece double "V" stainless steel tracks. The positive ball bearing sliding door retainers shall be adjustable for removal of the doors when required.
- D. Hinges on base and wall cabinets shall be exposed axle, zinc die cast with a satin chrome plated finish complying with BHMA A156.9, Grade 1 with antifriction bearings and rounded tips similar to units as manufactured by Richelieu #03H65 or Hettich #Selekta-4. Hinge shall be capable of supporting a 150 lb. dynamic load, 75 lbs on each side of the door located 12 inch from the hinge. Provide (2) hinges for 36 inch high doors, (3) for 48 inch high doors and (4) for 84 inch high doors. Hinges must be inset at door edge to achieve required gap tolerances.

- E. Door Catches: 3-barrel hinges have integral door catch mechanism. Catches shall be provided on hinged doors and shall be spring-loaded nylon roller types with a steel strike plate. Double doors without locks shall have a catch on each door. Tall cases shall have latching devices located on the structurally fixed center shelf. The left hand door shall have a positive catch and the right hand door shall have roller type catch. Where locks are used, catches and strike plates shall be used on left hand doors of double door cases and shall be steel, cadmium plated.
- F. Toe space filler: At gap created between the cabinet or ledge static panel and the floor due to leveling conditions, mechanically fasten (flat head screw) a 4 inch (101mm) wide 18 gage (1.21mm) galvanized steel plate to the cabinet behind the base molding to support its application. Provide continuous clear silicone sealant at intersection of floor/wall and steel plate.
- G. Drawer slides:
 - 1. Drawer slides shall be self-closing, ball bearing, full extension zinc plated assembly that will allow the drawer body to be completely exposed and physically accessible. Drawer slides shall have an integral stop mechanism to avoid inadvertent removal. Assembly shall be typically rated for 100 lb. at full extension, dynamic load. Slides shall be equal to Acuride Model 3832-SC or equal as manufactured by Precision Slide or Waterloo.
 - 2. Drawer slides for file or bin drawers shall be ball bearing, full extension zinc plated assembly that will allow the drawer body to be completely exposed and physically accessible. Drawer slides shall have an integral stop mechanism to avoid inadvertent removal. Assembly shall be typically rated for 150 lb. at full extension, dynamic load. Slides shall be equal to Acuride Model 4034 or equal as manufactured by Precision Slide or Waterloo.
- H. Shelf Adjustment: Adjustable shelf support clips inside wall, floor and base cabinets shall be designed for adjusting shelves on 1-1/4 inch (32mm) centers and shall be nylon complying with BHMA A156.9, Type B04013. Clip shall be configured to clamp top and bottom of shelf to avoid movement. Clip may have one or two pins. In addition to shelf clips required for initial assembly, six (6) dozen additional clips to be provided to the owner. Clips shall be Hafele #282.47.402 clear.
- I. Locks: Locks to be furnished where noted on the Drawings. Drawer and door locks shall be brass, five-pin tumbler type, complying with BHMA A156.11, Type EO7281 having para-centric keys. The exposed face shall be chromium plated with satin finish. Locks shall be mounted in special housing so designed as to prevent removal when in locked position. The locks and lock housings shall be fully concealed within the drawer heads and doors. The lock tongues shall engage the rails or stiles when in locked position. Sliding door locks shall be push-type operating in sleeves and engaging both doors when in locked position and provided with positive door holding device. Install theft panels above each drawer or cupboard segment in order to isolate locked section. Locks shall be separately keyed (including cabinets with multiple locks and cabinets in the same room) and two (2) keys shall be furnished with each lock. Supply two (2) master keys for all locks.
- J. Standards: Surface mounted adjustable shelves, shall be mounted to twin-tracked standards. Standards shall be coated with an epoxy powder coating complying with BHMA A156.9 Types

B04102 with a nominal cross section of 1-1/2 inch x 1/2 inch (38.1mm x 12.7mm). Acceptable manufacturers shall be Reeve, Fixture Hardware Manufacturing Corporation, and Knape and Vogt. Standards and slotted studs shall have a fully compatible slot pattern. Fasten standards to concrete masonry walls or properly blocked steel studded walls with appropriate flat head screws. Adjustable shelves, wall cabinets and drying racks will be furnished with integral mounting brackets or clips.

- K. Slotted Studs: Adjustable shelves, wall cabinets and drying rack boards mounted above peninsula or island benches shall be mounted to a welded double-sided, twin tracked stud assembly. Assembly shall be fabricated of 14 gage, fully welded with welds concealed, steel tube with slots laser cut into uprights and be coated with an epoxy powder coat. Acceptable manufacturers shall be Reeve, Fixture Hardware Manufacturing Corporation, and Knape and Vogt. Slotted studs and standards shall have a fully compatible slot pattern. Adjustable shelves, wall cabinets and drying racks shall be furnished with integral mounting brackets or clips to meet design load.
- L. File Drawers: File drawers shall be furnished with Pendaflex metal inserts to hold files in a front-to-back configuration. File drawer shall be notched appropriately to accept metal inserts.
- M. Grommets: Black ABS plastic wire access grommets shall be designed to accommodate computer and computer peripherals plugs up to 2-1/4 inch (60mm) wide. Unit shall be 3 inch (75mm) OD, require a 2-1/2 inch (65mm) hole and shall be configured with a separate and removable cap that completely covers the grommet liner. Unit shall be equal to Doug Mockett & Company #EDP Grommet or equal by Hafele.
- N. Sliding Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding door units.
- O. Glazing in doors shall be installed on a foam cushion with the glazing tape installed on sides trimmed below the level of the frame and glazing stops. Glazing stops shall be of the same material and finish as the cabinet door.
- P. Levelers are 3/8 inch – 16 NC x 3.5 inch long, model # 23015T56 as distributed by McMaster-Carr Supply Company, New Brunswick, NJ or equal.

2.17 MECHANICAL SERVICE FITTINGS

- A. Manufacturers. Service fittings shall be manufactured by:
 - 1. Water Saver Corporation,
 - 2. Far Laboratories,
 - 3. Broen Corporation.
 - 4. Chicago Faucets.
- B. Mechanical service fixtures shall comply with SEFA 7, "Laboratory and Hospital Fixtures-Recommended Practices. Fixtures for liquids and gaseous mixtures shall have lettered and colored indexes for each service. Handles shall be black, with color tabs identifying utility. Serrated hose ends shall have seven (7) serrations. Fixtures for gas, air and vacuum shall be

needle valve, large type. Water fixtures shall be compression type. Drain fittings shall be polypropylene unless otherwise noted. Fixtures that serve special gases (N2, O2, NO2, etc.) and instrument air shall be lubricated, cleaned, capped protected, and delivered certified for "Oxygen" service.

1. Provide fittings complete with washers, locknuts, nipples and other installation accessories necessary for final connection. Include the deck flanges, escutcheons, handle extension rods and similar items.
- C. Materials: Plumbing fixtures, except for drain fixtures and fittings, shall be a forged red-brass composition containing at least 85% copper with washers and seats, of maximum wear resistant materials for the specific use. Reagent grade water fixture to be brass gooseneck type with an internal polypropylene lining that permits recirculation to the manual outlet.
 - D. Needle Valves (Large): Provide large needle valves with a renewable valve seat and floating cone made of stainless steel or Monel metal with removable serrated outlet.
 - E. Compression Water Valves: Provide units complying with ASME A112.18.1. Compression water valves shall have a renewable unit containing all working parts, including a stainless steel replaceable seat and valve disc. Unit shall be broached on the outside for permanent position in the valve body. The unit shall contain an integral control device for volume of water discharged by the faucet. The valve shall have a removable serrated hose unless otherwise noted. Valve shall be rated for 125 psi (857 kPa) operating pressure with a max of 190 psi (1303 kPa) for intermittent use.
 - F. Faucet Accessories: Hot and cold water combination sink faucets shall have aerator tips. Cup sink and reagent grade water faucets to have serrated hose ends. Faucets are to be swivel type except reagent grade water.
 - G. Vacuum breakers shall be supplied on all domestic water fixtures. The fume hood fixture shall have the vacuum breaker exposed 7 feet (2133.6mm) A.F.F. on face of hood (exposed vacuum breaker and piping to have same finish as other fixtures). The vacuum breaker for the eye wash fixture shall be located under the sink cabinet, visible when the cabinet doors are open.
 - H. Industrial Water Sign: 1/8 inch thick black laminated plastic with engraved white letters "INDUSTRIAL WATER DO NOT DRINK". Provide a sign at all industrial hot and industrial cold water valves. At panel mounted valves mount sign on panel above valve handle and at all gooseneck fixtures provide with 3/8 inch thick split ring mounting bracket.
 - I. Hand Held Eye Wash: Where indicated with designation "EW" on floor plans, provide a unit that consists of a dual head eye wash assembly, 6 feet (1828.8mm) length of rubber hose, work surface mounting stand, slip ring mechanism to allow for hands free operation and in-line vacuum breaker. Unit's finish to match other service fittings.
 - J. Service Identification. Index buttons mounted in fixture handles shall identify the following services. Buttons shall be color-coded and lettered.

<u>SERVICE</u>	<u>LETTERING</u>	<u>DISC COLOR</u>
1. Hot Water	HW	Red
2. Cold Water	CW	Green
3. Gas	Gas	Blue
4. Air	Air	Orange

5.	Vacuum	Vac	Yellow
6.	Reagent Grade Water	RG	White
7.	Steam	STM	Black
8.	Nitrogen	N2	Brown
9.	Carbon Dioxide	CO2	Pink

- K. Service Fixture Finish. Laboratory brass service fixtures shall be ground smooth, coated with satin chromium plated finish with a clear epoxy coating except where corrosion resistant finish is indicated. Fixtures shall receive multiple applications of coating and are baked for polymerization. Units must be assembled before coating and pressure tested before shipment.
- L. Fixture Shipment. Fixtures shall be assembled in factory and supplied loose except for fume hood factory mounted fixtures.

2.18 SINKS

- A. General: Provide sinks and accessories as shown on the Drawings and as specified herein.
- B. Epoxy Resin Sinks: Molded in 1 piece with radiused corners, and bottom sloped to outlet with side mounted overflow; 1/2 inch (13mm) minimum thickness producing a smooth finish, the same color as the surrounding work surface.
- C. Provide each sink with an outlet, removable polypropylene disc strainer and tailpiece.
- D. Provide sinks for drop-in installation with 1/4 inch (6mm) thick lip around perimeter of sink. Top edge of sink shall be positioned 1/8 inch below the work surface with a 30 degree bevel from the top of the work surface to the top of the sink rim. Joint between sink and work surface shall not exceed an 1/8 inch.
- E. Stainless Steel Sinks: Made not less than 0.050 inch (1.3mm) thick. Fabricate with corners rounded and coved to at least 5/8 inch (16mm) radius. Slope sink bottom to outlet. Provide double wall construction for sink partitions with top edge rounded to at least 1/2 inch (13mm) diameter. Provide continuous butt-welded joints, grind smooth and polish surfaces to produce non-directional #4 satin finish, free of scratches. When polishing is completed rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean. Provide factory punchings for fittings, stainless steel strainers and tailpieces. Provide integral rims when not used with stainless steel work surfaces.
- F. Sink Supports: Epoxy and stainless steel sinks mounted in epoxy resin work surfaces shall be supported on steel channels under the sink and compressed by screw type rods to insure a tight fit to the underside of the work surface with a waterproof compound. Drop-in style epoxy sinks will also be acceptable.
- G. Overflow: Sinks shall be equipped with an overflow that is connected directly to the tailpiece. Overflow shall consist of an outlet located 2 inches (50.8mm) below the sink rim and 1/2 inch (25mm) diameter minimum flexible tygon or polypropylene tubing to connect overflow to tailpiece which shall be modified to accept tubing.
- H. Outlets and Tailpieces: Provide each sink with an outlet and tailpiece.

- I. Traps: Furnished under Division 22.

2.19 DRYING RACKS:

- A. Stainless Steel drying racks, as manufactured by Inter Dyne Systems, Inc. (Norton Shores, MI.) or United Lab Equipment, (Depew, NY) shall be furnished with removable rounded-tip white polypropylene pegs.
- B. Stainless steel drip trough, 1/4 inch (6mm) diameter drip trough outlet and flexible clear rubber tubing between drip trough outlet and sink (cut as required). Provide anti-splash screen in trough.
- C. Drying racks at umbilical shall be furnished with integral clips to attach to standards. Drying rack size and configuration shall be as indicated on the Drawings.
- D. Provide continuous silicone sealant at intersection between drying rack and trough.

2.20 ELECTRICAL FIXTURES

- A. General. Provide electrical fixtures in accordance with requirements in Division 26, complete with metal enclosure boxes, receptacles, terminals, switches, pilot lights, device plates, accessories and grommets. Cover plates to be stainless steel. Standard receptacles shall be white, receptacles connected to emergency power shall be red.
- B. Electrical Raceways.
 - 1. Electrical raceways mounted directly to partitions, reagent shelves or slotted studs will be supplied and installed under Division 26 Electrical.
 - 2. Electrical raceways mounted to movable tables with a fixed reagent shelf shall be furnished and installed by the laboratory casework manufacturer. Mount electrical raceway at centerline of table, directly under reagent shelf (cut reagent shelf supports as required). Provide double faced, UL approved electrical raceway with four 120v duplex receptacles per side spaced equally over 6 to 8 feet (304mm to 2438mm) length of table. Electrical raceway shall be equal to single compartment Wiremold # 3000. Color and finish of electrical raceway shall match laboratory casework. Provide hospital grade six foot long power cord and plug.
- C. Task Lights: Task lights located at under first shelf shall be supplied and installed by the casework manufacturer. Units shall be as follows:
 - 1. UL listed LED fixtures : Unit to be Vode LED 707 unit with clear lens and asymmetric distribution as manufactured by Vode Lighting, Sonoma, CA.
 - 2. Dimensions: 0.3 inch high by 1.14 inches deep by twenty-four inches, thirty-six inches, or forty-eight inches long. Fixtures to be manufacturer's standard lengths in longest possible size as appropriate for shelf length. Daisy chain multiple fixtures on each lab bench or wall elevation.

3. Housing: Anodized satin aluminum finish.
 4. Driver: Remote electronic driver mounted under top rail of movable laboratory bench or above top shelf at wall conditions. Driver housing shall be powder coated in a color to match metal laboratory casework. Driver on movable lab benches shall be plugged into outlet provided at top of side post. Driver at wall conditions shall be plugged into wall receptacle located below shelves. Route power cord down wall behind wall shelves.
 5. Power cord shall be white. Provide in appropriate length to reach electrical receptacle.
 6. Sound Rating A.
 7. Magnetic or clip mounting, aluminum shield/mounting channel accessory, cable management clips.
 8. Lamps: 5W/ft 3500K LED.
 9. Integrated occupancy sensor and on/off switch.
- D. Receptacles: Comply with NEMA WD 1, NEMA WD6, FS W-596 and UL 498, duplex type, Configuration 5 20R. Casework manufacturer will be responsible for providing appropriate cutout in their equipment to accommodate the outlet.
1. Receptacle Grade: Hospital grade, unless otherwise noted.
 2. GFCI Receptacles: Comply with UL 943, Hospital grade.
- E. Switches: Comply with FS W-C-896 and UL 20. Provide single pole, double pole or 3-way switches as required, rated 120 to 277 Vac. And in amperage capabilities to suit units served.
1. Provide pilot lights adjacent to toggle switches where noted as "PL" next to switch identification.
 2. Provide thermal overload switches, single or double pole, as required, with maximum over-current trip setting to suit particular motor controlled.
- F. Line Type Fittings: Provide with cast metal boxes with threaded holes for mounting on rigid steel conduit. Provide cover plates the same size as boxes.
- G. Cover Plates: Provide satin finish, chrome plated cover plates with formed, beveled edges.
- H. Cover Plate Identification: Use 1/4 inch (6mm) high letters. On stainless steel or chrome-plated metal, stamp or etch plate and fill in letters with black enamel. Provide at the following locations:
1. Receptacles other than standard 120v duplex, grounding type. Indicate voltage and phase.
 2. Switches and thermal overload switches. Indicate equipment being controlled.

3. Pilot lights when located remotely from associated equipment or switch, where function is not obvious. Indicate equipment being controlled.
4. Receptacles, switches and other locations indicated.

2.21 CONTROLLED ENVIRONMENT ROOM WALL MOUNTED SHELVING

- A. Where noted on drawings, provide full height 14 gage (1.9mm) heavy duty rolled steel channel type standards capable of mounting brackets for shelves and work surface at full length of the standard. They shall be bolted into blocking located in wall provided by Walk-in Room vendor.
- B. Shelving shall be 18 gage (1.27mm) type 304 stainless steel 12 inch (304.8mm) deep and be fabricated with a grid of oblong slots, 3/4 inch x 1-3/4 inch with 2-1/2 inch (19mm x 44.4mm with 63.5mm) lateral spacing to promote ventilation. Each shelf shall be supported with two brackets and be fastened to it.
- C. Brackets shall be 12 gage (2.78mm) type 304 stainless steel.
- D. Where stainless steel work surface is indicated on drawings, provide an appropriate set of brackets to support it without movement.

2.22 WIRE SHELVING

- A. Where noted on the Drawings, provide a wire shelving assembly that is 18 inches deep and 74 inches high. The entire assembly, consisting of a series of shelving units, shall be bolted together for overall stability and be installed in accordance with local seismic requirements.
- B. Shelving assembly shall consist of five tiers of wire shelving mounted on steel posts; one in each corner of each shelf. Each post shall have a leveling device. Shelves shall be adjustable in 1inch increments.
- C. Each four-foot length of shelf shall support up to 400 lbs.
- D. Shelving material shall be steel wire with polished chrome finish.
- E. Units shall be similar to Super Erecta Shelving as manufactured by InterMetro Wire Corporation (Wilkes Barre, PA.)

2.23 HEAVY DUTY SHELVING

- A. Where "HDS" is noted, provide a steel shelving assembly 60 inches wide x 24 inches deep x 72 inches high. It shall contain four (4) reinforced shelves and the entire assembly shall be fabricated of 14 gage steel and have a baked on gray finish. It shall be capable of supporting 1500 lbs per shelf. Unit shall be model # 467T56 as distributed by McMaster-Carr (New Brunswick, NJ) or approved equal.

PART 3 - EXECUTION

3.1 JOB SITE CONDITIONS

- A. Coordinate with the General Contractor to verify that required backing and reinforcements are in place, secure, and accurately located and that project is ready for installation of laboratory casework.
- B. Proceed with work when conditions permit Work to be installed in complete accordance with the original design, accepted submittals, and the manufacturer's written instructions.
- C. In the event of discrepancy, immediately notify the Architect in writing. Do not proceed with the installation in areas of discrepancy until issues have been resolved.

3.2 INSTALLATION

- A. Base Cabinet Casework shall be located in their designated positions, leveled, and plumbed true and straight by means of the micro-adjustment device located in each bottom corner of the cabinet. Adjust top rails and sub-tops within 1/16 inch (1.5mm) of a single plane. Fasten cabinets to utility space framing, partition framing, blocking or reinforcements in partitions with fasteners spaced not more than 24 inches (600mm) O.C. Align similar adjoining doors to a tolerance of 1/16 inch (1.5mm).
- B. Work surface lengths shall be fabricated as specified and indicated on the Drawings with ends abutting tightly, and sealed with corrosion resistant sealants. The horizontal surface shall be smooth and level with no raised edges at the joints. Work surfaces shall be anchored to base cabinets.
- C. Install miscellaneous filler panels and scribe as required for a continuous tight and accurate fitting installation with fasteners concealed where practical, without gaps or spaces between cabinet work or work surfaces and adjoining surfaces. All back splashes to be sealed at wall surfaces with corrosion resistant sealants.
- D. Assemblies are to be fastened together with devices of adequate strength to support cabinet or shelf fully loaded. Fully loaded will be defined as twenty-five (25) pounds per linear foot per shelf for enclosed wall cabinets or open adjustable shelves not inclusive of cabinet, shelf and bracket weight. Securely fasten wall-mounted items to solid supporting material only. Installation to meet local seismic requirements.
- E. Wall Cabinets: Adjust fronts and bottoms within 1/16 inch (1.5mm) of a single plane. Fasten to hanging strips, masonry, partition framing, blocking or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600mm) O.C. Align similar adjoining doors to a tolerance of 1/16 inch (1.5mm).
- F. Utility Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- G. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

- H. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate joints only where shown on Shop Drawings.

3.3 WORK SURFACE INSTALLATION

- A. Work surface lengths shall be fabricated as specified and indicated on the drawings with ends abutting tightly in a hairline joint, single true plane, smooth and level with no raised edges at the joints with supports place to prevent deflection. All joints are to be sealed with corrosion resistant sealants. Wall-to-wall work surfaces are to be installed with a maximum 1/4 inch (6.35mm) gap.
- B. Make field jointing in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted submittal drawings. Joints shall be factory prepared requiring no job site processing of top and edge surfaces.
- C. Work surfaces shall be anchored to base cabinets. Secure work surfaces to cabinets/supports with concealed "Z" type angles or equal fastening devices spaced no more than 24 inches (610mm) on center, with one located within 6 inches (150mm) of front and back edge. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints. Countersink exposed heads approximately 1/8 inch (3mm) and plug flush with material equal in chemical resistant, color, harshness and texture to adjoining surface. Where work surface is intended to be moveable use a clamping device that is removable. Work surfaces to be installed with a maximum 1/8 inch gap. Secure epoxy work surfaces to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches (1200mm) O.C.
- D. Provide holes and cutouts as required for equipment and service fittings and fixtures. Verify size of opening with actual size of item to be used, prior to making openings. Form inside corners to a radius of not less than 1/8 inch (3mm). After cutting, rout and file cutouts to ensure smooth, crack-free edges. Seal exposed edges after cutting with a chemical resistant sealer recommended by the manufacturer.
- E. Provide scribe moldings for closures at junctures of work surface, curb and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- F. Carefully dress joints smooth, remove surface scratches and clean entire surface.

3.4 INSTALLATION OF ACCESSORIES

- A. Install in accordance with manufacturer's directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.
- B. Securely fasten adjustable shelving supports, shelves and drying rack to partition framing, blocking or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.5 CLEANING

- A. Repair or remove and replace defective, damaged or soiled work to match original factory finish.
- B. Clean finished surfaces, including wiping of drawers and cabinet shelves, touch up as required.
- C. Clean work surfaces leaving tops free of grease and streaks. Use no wax or oils.

3.6 PROTECTION

- A. Protect against soiling and deterioration during remainder of construction period.
- B. Protect work surfaces and ledges for the remainder of the construction period with 1/4 inch (6mm) corrugated cardboard or equal completely covering the top and securely taped to edges. Mark cardboard in large lettering "No Standing".

END OF SECTION

BLANK PAGE

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Project is to remove and replace existing fire sprinkler heads with new flat plate concealed type.
- B. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
- C. All black steel sprinkler pipe shall have a wall thickness less than or equal to schedule 40 and greater than schedule 10.
 - 1. Exception: Pipe with a nominal pipe size of 6 inches and greater may be schedule 10.
- D. Final acceptance of the automatic sprinkler systems by insurance provider is contingent upon field investigation and satisfactory completion of the Contractor's Material & Test Certificate.
- E. No systems can be touching the fire sprinkler piping.
- F. Summary Table:

Item	Summary
Interior pipe type	Mains: Schedule 10 (2 1/2" diameter and larger) Branchlines: Schedule 40 (2" diameter and smaller) Dry Pipe: Schedule 40
Sprinkler Finish	Flat Plate Concealed, except uprights and storage
Center of Tile	Required, Center thirds are acceptable for rectangular tiles
Flexible Sprinkler Drops	Designers preference
FM Global	No
Calculations	Required, use reduced flow data
Seismic	Calculations using $S_S = 1.17$ g, unless otherwise specified by structural engineer.

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.

- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Design sprinkler piping according to the following and obtain approval from architect, prior to submitting to other authorities having jurisdiction:
 - 1. The following 10% reduced flow data is for informational purposes only, new flow test information shall be provided:

Flow data available at 2000 Circle of Hope Dr., Salt Lake City, UT 84112

Static – 108 psi

Residual – 18 psi @ 10,000 gpm flowing

Date of Test – 07/01/2019 by SLC Public Utilities.
 - 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 3. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Office and Public Areas: Light Hazard.
 - 4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft..
 - b. Storage Areas: 130 sq. ft..
 - c. Mechanical Equipment Rooms: 130 sq. ft..

- d. Electrical Equipment Rooms: 130 sq. ft..
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
- a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
7. Sprinklers are to be installed throughout the premises, as required by NFPA 13.
- C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

1.6 SUBMITTALS

- A. Product Data: For the following:
- 1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
 - 2. Pipe hangers and supports, including seismic restraints.
 - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable. Drawings are to be approved by Architect prior to submission to State Fire Marshal.
- C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- D. Welding certificates.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
- 1. An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Architect requires evidence to support the ability of the subcontractor to perform work in the scope and volume as specified. A subcontractor, who cannot show such experience, may be found not suitable to perform the work. The following are the approved subcontractors for this project:

- a. PRE-APPROVED SUBCONTRACTORS LIST
 - 1) Alta Fire
 - 2) Certified Fire
 - 3) Chaparral Fire
 - 4) Delta Fire
 - 5) Preferred Fire Protection
 - 6) Quality Fire Protection
 - 7) Fire Services Inc.
 - 8) FireTrol
 - 9) Simplex-Grinnell
 - 10) State Fire DC Specialties
 - 11) The Safety Team
 - 12) Western Automatic
 - 13) Kimco
 - 14) Or prior approved equal
 - b. A subcontractor not listed in the "PRE-APPROVED SUBCONTRACTORS LIST" must receive prior approval from the architect to bid this project.
- B. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional designing services needed to assume designing responsibility. Base calculations on results of fire-hydrant flow test.
- 1. Design Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level III technician.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
- 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- E. International Conference of Building Code Officials codes and standards complying with the following:
- 1. IBC-2021, "International Building Code."
 - 2. IFC-2021, "International Fire Code."
- F. Utah Amendments
- 1. Title 15A
- 1.8 COORDINATION
- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- 1.9 GENERAL DESIGN QUALITY
- A. Unless noted otherwise the following applies:
 - 1. The maximum water velocity shall not exceed 32-fps.

2. Submit the calculations using the reduced flow data.
3. In the event of multiple (3) submittal rejections (including revise and resubmit) a meeting shall be held at the architect's office at the architect time of choosing and the designer and general contractor shall be physically in attendance to discuss the required modifications to the design.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, Class 53, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.

2.3 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.
 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Victaulic Co. of America.
 - 4) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.4 EXCLUDED STEEL PIPE AND FITTINGS

- A. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 is not allowed.
- B. Plain-End, Nonstandard OD, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 10 is not allowed.
- C. Plain-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5 is not allowed.
- D. Grooved-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5; with factory- or field-formed, roll-grooved ends are not allowed.
- E. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with plain ends is not allowed.

2.5 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper; with plain ends.
 1. Copper fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.

- B. Plain-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L, water tube, drawn temper.
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match tubing system.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 4. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube not allowed.
 - 5. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.

- C. Grooved-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L, water tube, drawn temper; with factory- or field-formed, roll-grooved ends.
 - 1. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube not allowed.
 - 2. Grooved-Joint Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Victaulic Co. of America.
 - b. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting. Fittings may have ends factory or field expanded to steel-pipe OD if required for copper tube systems using grooved-end-pipe couplings.
 - c. Grooved-End-Tube Couplings: UL 213, rigid pattern, unless otherwise indicated; gasketed fitting equivalent to AWWA C606, but made to match copper-tube OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts. Use grooved-end-pipe couplings for tube and fitting that have expanded ends.

2.6 DIELECTRIC FITTINGS

- A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.

- B. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.

- C. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:

- a. Advance Products and Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Insert manufacturer's name.
- D. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.
- 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- E. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.
- 1. Manufacturers:
 - a. Perfection Corporation.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Co. of America.

2.7 FLEXIBLE SPRINKLER DROPS

- A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
- 1. NPS 1: Threaded.
- B. Manufacturers:
- 1. Flex-Head
 - 2. Victaulic
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.8 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be FMG approved with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Where indicated for system pressure above 175-psig, sprinkler specialty fittings shall have 250-psig minimum working-pressure rating.

- B. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- C. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- D. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
- E. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.9 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be FMG approved, with 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

2.10 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.11 SPECIALTY VALVES

2.12 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum pressure rating if sprinklers are components of a high-pressure piping system.
- B. Manufacturers:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Johnson Controls.
 - 3. Reliable Automatic Sprinkler Co., Inc.
 - 4. Victaulic Co. of America.
 - 5. Viking Corp.
 - 6. Tyco Fire, a subsidiary of Johnson Controls
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
 - 2. UL 1626, for residential applications.

- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
 - 1. Concealed ceiling sprinklers, including cover plate.
 - 2. Extended-coverage sprinklers, not allowed unless approved in writing prior to bidding.
 - 3. Flow-control sprinklers, with automatic open and shutoff feature.
 - 4. Flush ceiling sprinklers, including escutcheon, not allowed.
 - 5. Institution sprinklers, made with a small, breakaway projection.
 - 6. Pendent sprinklers.
 - 7. Pendent, dry-type sprinklers.
 - 8. Quick-response sprinklers.
 - 9. Recessed sprinklers, including escutcheon.
 - 10. Sidewall sprinklers.
 - 11. Sidewall, dry-type sprinklers.
 - 12. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted. Finishes as approved by FM Global.
- G. Special Coatings: Wax, lead, and corrosion-resistant paint.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Flat plate concealed, white.
 - 2. Sidewall Mounting: Semi-Recessed, white.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Sprinkler Main Piping: Use the following:
 - 1. NPS 2 1/2 and Larger: Standard-weight steel pipe with threaded ends, or grooved ends. No plain ends allowed.
 - 2. Outlets shall be welded.
- E. Branch line piping: Use the following:

1. NPS 2 and Smaller: Threadable steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

F. Standpipes and mains: Use the following:

1. NPS 2 1/2 to NPS 6: Schedule 10 steel pipe with grooved ends & Welded outlets.
2. NPS 2 and Smaller: Schedule 40 steel pipe with threaded ends, or grooved ends. No plain ends allowed.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13 and NFPA 14.
2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13 and NFPA 14.
 - a. Shutoff Duty: Use gate, ball, or butterfly valves.
 - b. Throttling Duty: Use globe, ball, or butterfly valves.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping joint construction.
- B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
- C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- C. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- E. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- F. Install sprinkler piping with drains for complete system drainage.
- G. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- H. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.
 - 1. No powder driven studs allowed.
 - 2. Wrap-around braces are to be provided at end of branch lines.
- I. Earthquake Protection: Install piping according to NFPA 13-9.3 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.
- J. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.
- K. When a fire pipe crosses a seismic expansion joint it shall have a Metraflex fire loop installed at the joint in accordance with NFPA 13 chapter 9.

3.5 SPECIALTY SPRINKLER FITTING INSTALLATION

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.6 VALVE INSTALLATION

- A. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.
- B. Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

3.7 SPRINKLER APPLICATIONS

- A. General: All sprinklers are to be quick response type. Sprinklers shall be of the latest design closed spray type for 155°F unless specified otherwise or required by code. Extended coverage sprinklers shall not be used. Orifices larger than 1/2" may be used as required by density and spacing demands. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
2. Rooms with Ceilings: Flat plate concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers with recessed escutcheon.
4. Institutional sprinklers shall be installed in areas of detention, correctional or mental health care facilities.
5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
6. Provide freeze proof type automatic sprinkler heads serving unconditioned spaces, areas subject to freezing and in other areas requiring their use.
7. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
8. Sprinkler Finishes: Use sprinklers with the following finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
 - b. Concealed Sprinklers: Rough brass, with White cover plate to match ceiling color.
 - c. Semi-Recessed Sprinklers: White, with FMG approved white escutcheon.

B. Sprinklers: Use the following:

1. All sprinklers shall be listed, quick response type.
2. Sprinkler in future finish spaces (shelled) 10' x 10' spacing shall be pendants/uprights installed with 1 x 1/2" bushing, to accommodate future finishes.
3. Finish ceiling spaces shall have flat plate type cover plate.

3.8 SPRINKLER INSTALLATION

- A. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads should be symmetrical and all piping run parallel or perpendicular to building lines.
1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions and HVAC ductwork.
 2. Sprinkler heads shall not conflict with tile grids.
 3. Sprinkler heads shall be located near center of corridors.
- B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect or such locations shown do not meet the requirements of NFPA-13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. The sprinkler layout, where shown, does not necessarily include all sprinklers required; and additional sprinklers required for any reason, to conform to NFPA 13 requirements, shall be included in the Shop Drawings and provided at no cost to the University.
- C. Install sprinklers in patterns indicated.
- D. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

- E. Future finish shelled and tenant finish; Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x 1/2" bushings, and space heads at a maximum spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.
- F. Concealed type sprinkler shall be installed throughout project as allowed by NFPA 13.

3.9 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 23 Section "Common Work Result for HVAC."

3.10 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Flush, test, and inspect standpipes according to NFPA 14, "Tests and Inspection" Chapter.
- C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- D. When making a mechanical tee connection the coupon shall be attached at the mechanical tee.
- E. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- F. Whether the underground serving the sprinkler system is done by this subcontractor or another, this subcontractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and tested by the subcontractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.

3.12 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

3.13 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete and that "Material Test Certificates" are complete.

- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Fill wet-pipe sprinkler piping with water.
- F. Fill standpipes with water.
- G. Coordinate with fire alarm tests. Operate as required.

3.14 DEMONSTRATION & TESTS

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi in excess of the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.
- C. The local jurisdiction having authority and the Utah State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.
- D. This subcontractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Subcontractor Test Certificates for the overhead, backflow and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.
- E. All tests requiring the witnessing by local authorities will be the responsibility of this subcontractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this subcontractor.

3.15 WARRANTY

- A. This subcontractor shall warranty the sprinkler system and all its components, including all major pieces of equipment including items such as pumps, fire pump controllers, and nitrogen generators for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this subcontractor.
- B. Provide Operation and Maintenance Manuals with correct as-builts test certificates and warranties included. A minimum 6 sets to be provided in red 3-ring binders. Include a current adopted version of NFPA 25 softbound copy left with owner.

- C. Electronic copy of AutoCAD as-built drawings shall also be provided on CD, with each O&M Manual.

3.16 FIELD QUALITY CONTROL

- A. Flush, test and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 211000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 1. Piping materials and installation instructions common to most piping systems.
 2. Transition fittings.
 3. Dielectric fittings.
 4. Equipment installation requirements common to equipment sections.
 5. Painting and finishing.
 6. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.

- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:

- a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

PART 3 - EXECUTION

3.1 SEISMIC REQUIREMENTS

- A. Comply with SEI/ASCE 7 and with requirements for seismic seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate

friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to 2 inch (50mm), tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with chrome-plated finish.

- d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
- f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
- h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
- i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
- j. Bare Piping 2 inch and Smaller in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
- k. Bare Piping in Equipment Rooms Larger than 2 inch: One-piece, stamped-steel type with chrome- or cadmium-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Bronze ball valves.

B. Related Sections:

- 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
 - k. Class: 250

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.

- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.
- k. Class: 250

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. DynaQuip Controls.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Red-White Valve Corporation.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- k. Class: 250

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.
- k. Class: 250

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.
 3. Ball Valves: One, Two or Three piece, full, bronze with bronze or stainless-steel trim.
 4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.
 5. Bronze Globe Valves: Class 125 or Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.
 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze, ductile-iron or stainless-steel disc.
 4. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
 5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring weight.
 6. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250 or Class 300, compact-wafer, metal seat.
 7. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250 or Class 300; single plate; metal seat.
 8. Iron Globe Valves: Class 125 or Class 250.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
 - 3. Division 23 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

- C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.
1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems.
 4. Pipe positioning systems.
 5. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
- C. Welding certificates.
- D. Delegated-Design Submittal:
1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 4. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Project specific design documentation and calculations shall be prepared and stamped by a registered professional engineer who is responsible for the seismic restraint design and who is licensed in the state where the project is being constructed (ASCE 7, 13.2.1.1).

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. Anvil International.
 - 2. AAA Technology & Specialties Co., Inc.
 - 3. Bergen-Power Pipe Supports.
 - 4. B-Line Systems, Inc.; a division of Cooper Industries.
 - 5. Carpenter & Paterson, Inc.
 - 6. Empire Industries, Inc.
 - 7. ERICO/Michigan Hanger Co.
 - 8. Globe Pipe Hanger Products, Inc.
 - 9. Grinnell Corp.
 - 10. GS Metals Corp.
 - 11. National Pipe Hanger Corporation.
 - 12. PHD Manufacturing, Inc.
 - 13. PHS Industries, Inc.
 - 14. Piping Technology & Products, Inc.
 - 15. Tolco Inc.
 - 16. Simpson Strong-Tie Co.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Manufacturers:

1. Anvil International.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. GS Metals Corp.
5. Hilti, Inc.
6. Power-Strut Div.; Tyco International, Ltd.
7. Thomas & Betts Corporation.
8. Tolco Inc.
9. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Manufacturers:

- a. Hilti, Inc.
- b. MKT Fastening, LLC.
- c. Powers Fasteners.
- d. Simpson Strong-Tie Co.

- B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: '**'

- 1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.
- g. Simpson Strong-Tie Co. *

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

- B. Manufacturers:

- 1. C & S Mfg. Corp.
- 2. HOLDRITE Corp.; Hubbard Enterprises.
- 3. Samco Stamping, Inc.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
 - M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
 - N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
 - O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder actuated fasteners shall not be used for seismic bracing attachments.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report
- G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.
 - 7. Ceiling grid

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 1. Stencil Material: Fiberboard or metal.
 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

2.7 CEILING GRID

- A. Provide valve identification for all plumbing and med gas valves located above the ceiling on the ceiling grid below the valve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each main run. Branch piping & piping in congested areas are to have labels spaced at maximum intervals of 6 feet.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. On hard lid ceilings where piping enters and exits the room.

D. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.
2. Medium-Pressure, Compressed-Air Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.
3. Domestic Water Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.
4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
 - d. High-Pressure Compressed Air: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Cold Water: Comply with ASME A13.1.
 - b. Hot Water: Comply with ASME A13.1.
 - c. Low-Pressure Compressed Air: Comply with ASME A13.1.
 - d. High-Pressure Compressed Air: Comply with ASME A13.1.

3. Letter Color:

- a. Cold Water: Comply with ASME A13.1.
- b. Hot Water: Comply with ASME A13.1.
- c. Low-Pressure Compressed Air: Comply with ASME A13.1.
- d. High-Pressure Compressed Air: Comply with ASME A13.1.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.

1.3 DEFINITIONS:

- A. Refer to Section 220500 "Common Work Results for Plumbing".

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation for below-ambient service requires a vapor-barrier.

- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553:
 - 1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A,
 - a. Without factory-applied jacket with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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

a. Ramco Insulation, Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

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

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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

a. Aeroflex USA, Inc.; Aero seal.

b. Armacell LLC; Armaflex 520 Adhesive.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.

d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.

d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F .
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F .
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F .
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 SEALANTS

- A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F .
 5. Color: White.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: PVC, white: 30 mils thick..
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper. 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
 - a. 2 inches o.c.
 - b. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
 - N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
 - O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
 - P. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1-1/2 and Smaller: Insulation shall be one of the following;
 - a. Flexible Elastomeric:
 - 1) 1/2 inch thick
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1/2 inch thick
 - 2. NPS 2 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric:
 - 1) 1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation:
 - 1) 1/2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1 inch thick.

2. NPS 2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1-1/2 inches thick

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F :

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric:
 - 1) 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 3/4 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
- D. Piping, Exposed:
 1. PVC:
 - a. PVC, white: 30 mils thick.

END OF SECTION

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
- C. All piping shall be American made and tested; no import pipe will be permitted.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Appurtenances for Grooved-End Copper Tubing:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Nipples and Waterways:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Clearflow/Perfection Corp.
 - e. Precision Plumbing Products, Inc.
 - f. Victaulic Company.
 - 2. Standard: IAPMO PS 66 or ASTM F-1545-97.
 - 3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF-61 Compliant.
 - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 5. End Connections: Male threaded or grooved.
 - 6. Lining: Inert and noncorrosive, propylene or LTHS.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."
- G. Install domestic water piping with 0.25 percent slope downward toward drain and plumb.
 - 1. Piping will be drained seasonally for freeze protection.
- H. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Division 22 Section.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."
- R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."
- S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples/waterways.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples/waterways.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric nipples/waterways.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

- A. Some piping types and sizes mentioned in this section may not be used on this project.
- B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- copper, brazed-joint fittings; and brazed joints.
 2. Victaulic grooved joints
- G. Aboveground domestic water piping, NPS 5 and larger, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- copper, brazed-joint fittings; and brazed joints.
2. Victaulic grooved joints

3.12 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball for piping NPS 3 and smaller. Use butterfly or ball, with flanged ends for piping NPS 4 and larger.
 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 1. For piping with a seismic importance factor of 1.0 the term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. For piping with a seismic importance factor of 1.5 the term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor's expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AB&I Foundry
- b. Charlotte Pipe
- c. Tyler Pipe

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO.
 - b. Ideal
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - d. Tyler Pipe.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Husky SD 4000.
 - b. Clamp-All Corp HI-TORQ 125.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent Cement: ASTM D 2564.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert.
- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."
- S. Vents shall extend full size through roof and shall project minimum 18-in above the roof.

3.2 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling or valve and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for **double-containment** PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- I. Install supports for vertical **double-containment** PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."

6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make fixture and equipment connections according to the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.5 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without

introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.7 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 3 and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 4 and larger shall be the following:
 1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 3 and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 4 and larger shall be the following:
 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- F. PVC piping in first subparagraph below is limited in size to NPS 12 (DN 300).
- G. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories bathtub/showers showers and sinks.
 - 2. Commercial sinks.
- B. Related Sections include the following:
 - 1. Division 22 Section "Emergency Plumbing Fixtures."

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. FRP: Fiberglass-reinforced plastic.
- F. PMMA: Polymethyl methacrylate (acrylic) plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 WARRANTY

- A. Provide a one year factory warranty for all fixtures, faucets and valves from the date of substantial completion.

1.5 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 6. Vitreous-China Fixtures: ASME A112.19.2M.
 - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 8. Whirlpool Bathtub Fittings: ASME A112.19.8M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.
13. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
8. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SINK FAUCETS

A. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.

2.2 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.3 COMMERCIAL SINKS

A. Commercial Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

- M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- O. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

- D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following emergency plumbing fixtures:
 - 1. Eyewash equipment.

1.3 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
- D. Tepid: Moderately warm.

1.4 WARRANTY

- A. Provide a one year factory warranty for all fixtures, faucets and valves from the date of substantial completion.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ; for plumbing fixtures for people with disabilities.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 EYE/FACE WASH EQUIPMENT

- A. Eye/Face Wash Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian G1806 recessed swing down Eye/Face Wash Unit complete with thermostatic mixing valve or a comparable product by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.
 - c. Guardian Equipment Co.
 - d. Haws Corporation.
 - e. Lab Safety Supply Inc.
 - f. Murdock, Inc.
 - g. Sellstrom Manufacturing Co.
 - h. Speakman Company.
 - i. Stingray Systems.
 - j. WaterSaver Faucet Co.
 - k. Western Emergency Equipment.
 - l. Acorn Engineering
 - 3. Description: Plumbed, recessed eye/face wash equipment.
 - a. Capacity: Deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: swing down.
- B. Standard, Freestanding, Plumbed Eyewash Units, :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acorn Safety; a division of Acorn Engineering Company.
- b. Bradley Corporation.
- c. Encon Safety Products.
- d. Guardian Equipment Co.
- e. Haws Corporation.
- f. Sellstrom Manufacturing Company.
- g. Speakman Company.
- h. Stngray Systems.
- i. WaterSaver Faucet Co.

2. Capacity: Not less than 3.0 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Two receptor-mounted spray heads.
6. Receptor: Stainless-steel bowl.
7. Mounting: Pedestal.

2.2 SOURCE QUALITY CONTROL

- A. Certify performance of plumbed emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping.

- F. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
- G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- I. Fill self-contained fixtures with flushing fluid.
- J. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.
- C. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.
- B. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.
 - 1. Test and adjust controls and safeties.
- C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- D. Report test results in writing.

3.5 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION

SECTION 226113 - COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

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. Healthcare laboratory compressed-air piping, designated "instrument air."

1.3 DEFINITIONS

- A. Medical compressed-air piping systems include instrument air.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Seismic Qualification Certificates: For medical compressed-air manifolds, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Material Certificates: Signed by Installer certifying that medical compressed-air piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.
- D. Brazing certificates.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 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. Laboratory valve and nozzle.
 - a. Instrument Air: Equal to 10 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Medical Air Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
 - 2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Instrument air operating at 175 psig.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Medical compressed-air manifolds shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and with the requirements specified in Section 230548 Vibration and Seismic Controls for Plumbing Piping and Equipment.
 - 1. The term "withstand" means "the manifold will remain in place without separation of any parts when subjected to the seismic forces specified and the manifold will be fully operational after the seismic event."

2. Component Importance Factor is 1.5.

2.3 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical air piping materials.
- B. Comply with ASME B31.9, "Building Services Piping," for instrument air piping operating at 150 psig or less.
- C. Copper Medical Gas Tube: ASTM B 819, Type K and Type L, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.
- D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
- E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, full-face type.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- G. Shape-Memory-Metal Couplings:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Aerofit, Inc.
 - b. Smart Tap, Inc.
 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
- H. Flexible Pipe Connectors:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Mercer Gasket & Shim, Inc.
 - e. Metraflex Company (The).
 - f. Proco Products, Inc.
 - g. Unaflex.
 - h. Universal Metal Hose; a Hyspan Co.

3. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig minimum.
 - b. End Connections: Plain-end copper tube.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.

2.5 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:

a. Steel Box with Aluminum Cover:

- 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2) Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a) Allied Healthcare Products Inc.
 - b) Amico Corporation.
 - c) Ohio Medical Corporation.
 - d) BeaconMedaes
 - e) Patton's Medical

- b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

- 1) Interior Finish: Factory-applied white enamel.
- 2) Cover Plate: Aluminum with frangible or removable windows.
- 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. BeaconMedaes.

- d. Conbraco Industries, Inc.
- e. Marwin Valve; a division of Richards Industries.
- f. NIBCO INC.
- g. Ohio Medical Corporation.
- h. Tri-Tech Medical Inc.
- i. Patton's Medical

3. Standard: MSS SP-110.
4. Description: Three-piece body, brass or bronze.
5. Pressure Rating: 300 psig minimum.
6. Ball: Full-port, chrome-plated brass.
7. Seats: PTFE or TFE.
8. Handle: Lever type with locking device.
9. Stem: Blowout proof with PTFE or TFE seal.
10. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

D. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

2.6 MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

A. Basis-of-Design Product: Subject to compliance with requirements, provide lab type wall mounted valve with flange and laboratory 10 serration nozzle compatible outlets by one of the following:

1. Amico Corporation.
2. Chicago Faucets.

B. General Requirements for Medical Compressed-Air Service Connections:

1. Suitable for specific medical air pressure and service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
3. Double seals that will prevent air leakage.
4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:

1. Brass housing with primary check valve.
2. Double seals that will prevent air leakage.
3. Cover plate with gas-service label.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
 2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of compressed-air piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install compressed-air piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

- K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections.
- O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.
- P. Piping Restraint Installation: Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 230548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- Q. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- R. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
- S. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on compressed-air piping where reduced pressure is required.
- F. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

3.4 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- B. Threaded Joints: Apply appropriate tape to external pipe threads.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
- D. Flanged Joints: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION

- A. Install compressed-air pressure control panel in walls. Attach to substrate.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 3/4: 84 inches with 3/8-inch rod.
 - 4. NPS 1: 96 inches with 3/8-inch rod.

5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.

- J. Install supports for vertical copper tubing every 10 feet.

3.7 IDENTIFICATION

- A. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
1. Medical Air: Black letters on yellow background.
 2. Instrument Air: White letters on red background.
 3. Medical Laboratory Air: Black letters on yellow-and-white checkerboard background.

3.8 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical compressed-air piping in healthcare facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
1. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of medical gas piping and medical vacuum piping systems.
 2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blowdown.
 - b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for positive-pressure medical compressed-air piping.
 - f. Repair leaks and retest until no leaks exist.
 3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 - a. Standing pressure test.
 - b. Individual-pressurization or pressure-differential cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Piping particulate test.
 - g. Piping purity test.

- h. Final tie-in test.
 - i. Operational pressure test.
 - j. Medical air purity test.
 - k. Verify correct labeling of equipment and components.
 - 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.9 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.10 PIPING SCHEDULE

- A. Connect new tubing to existing tubing with memory-metal couplings.
- B. Flanges may be used where connection to flanged equipment is required.
- C. Medical Air Piping and Instrument Air Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

3.11 VALVE SCHEDULE

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION

SECTION 226213 - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

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. Medical-surgical/Laboratory vacuum piping, designated "medical vacuum."

1.3 DEFINITIONS

- A. WAGD: Waste anesthetic gas disposal.
- B. Medical vacuum piping systems include medical vacuum, and medical laboratory vacuum piping systems.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: Signed by Installer certifying that medical vacuum piping materials comply with requirements in NFPA 99.
- C. Brazing certificates.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 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. Laboratory valve and nozzle.
 - a. Instrument Air: Equal to 10 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Medical Vacuum Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
 - 2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Medical vacuum operating at 15 in. Hg.

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical vacuum piping materials.
- B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
- C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.
- D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

- E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

- F. Shape-Memory-Metal Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Aerofit, Inc.
 - b. Smart Tap, Inc.
 - 3. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

- G. Flexible Pipe Connectors:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, product by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Mercer Gasket & Shim, Inc.
 - e. Metraflex Company (The).
 - f. Proco Products, Inc.
 - g. Unaflex.
 - h. Universal Metal Hose; a Hyspan Co.
 - 3. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig minimum.
 - b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- C. Threaded-Joint Tape: PTFE.

2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
1. Zone-Valve Boxes:
 - a. Steel Box with Aluminum Cover:
 - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2) Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a) Allied Healthcare Products Inc.
 - b) Amico Corporation.
 - c) Ohio Medical Corporation.
 - d) BeaconMedaes
 - e) Patton's Medical
 - b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
 - 1) Interior Finish: Factory-applied white enamel.
 - 2) Cover Plate: Aluminum with frangible or removable windows.
 - 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- C. Copper-Alloy Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. BeaconMedaes.
 - d. Conbraco Industries, Inc.
 - e. Marwin Valve; a division of Richards Industries.
 - f. NIBCO INC.
 - g. Ohio Medical Corporation.
 - h. Tri-Tech Medical Inc.
 - i. Patton's Medical
 3. Standard: MSS SP-110.
 4. Description: Three-piece body, brass or bronze.
 5. Pressure Rating: 300 psig minimum.

6. Ball: Full-port, chrome-plated brass.
7. Seats: PTFE or TFE.
8. Handle: Lever type with locking device.
9. Stem: Blowout proof with PTFE or TFE seal.
10. Ends: manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. BeaconMedaes.
 - d. Conbraco Industries, Inc.
 - e. Ohio Medical Corporation.
 - f. Tri-Tech Medical Inc.
 - g. Patton's Medical
3. Description: In-line pattern, bronze.
4. Pressure Rating: 300 psig minimum.
5. Operation: Spring loaded.
6. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.5 MEDICAL VACUUM SERVICE CONNECTIONS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide lab type wall mounted valve with flange and laboratory 10 serration nozzle compatible outlets by one of the following:
 1. Amico Corporation.
 2. Chicago Faucets.
- B. General Requirements for Medical Vacuum Service Connections:
 1. Suitable for specific medical vacuum service listed.
 2. Include roughing-in assemblies and finishing assemblies.
 3. Recessed-type units made for concealed piping unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of vacuum piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install vacuum piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install piping to permit valve servicing.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- N. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 230548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- O. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Apply appropriate tape to external pipe threads.
- E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.
- F. Flanged Joints:
 - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
 - 2. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- G. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 3/4: 84 inches with 3/8-inch rod.
 - 4. NPS 1: 96 inches with 3/8-inch rod.
 - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
 - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
 - 7. NPS 2: 11 feet with 3/8-inch rod.
 - 8. NPS 2-1/2: 13 feet with 1/2-inch rod.
 - 9. NPS 3: 14 feet with 1/2-inch rod.
 - 10. NPS 3-1/2: 15 feet with 1/2-inch rod.
 - 11. NPS 4: 16 feet with 1/2-inch rod.
 - 12. NPS 6: 20 feet with 5/8-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.

3.6 IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Medical Vacuum: Black letters on white background.

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
 - 1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
 - 2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blowdown.
 - b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for vacuum systems.
 - f. Repair leaks and retest until no leaks exist.
 - 3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 - a. Standing pressure test.
 - b. Individual-pressurization or pressure-differential cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Final tie-in test.
 - g. Operational vacuum test.
 - h. Verify correct labeling of equipment and components.
 - 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NONMEDICAL VACUUM PIPING

- A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of vacuum piping in nonmedical laboratory facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

- a. Test Pressure for Copper Tubing: 100 psig.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect filters for proper operation.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.9 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.10 PIPING SCHEDULE

- A. Connect new copper tubing to existing copper tubing with memory-metal couplings.
- B. Flanges may be used where connection to flanged equipment is required.
- C. Medical Vacuum Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.
- D. WAGD Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.

3.11 VALVE SCHEDULE

- A. Shutoff Valves:
 - 1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION

SECTION 226313 - GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

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. Natural gas piping, designated "natural gas."

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. Medical gas piping systems include natural gas for healthcare facility.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: Signed by Installer certifying that medical gas piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.
- C. Brazing certificates.
- D. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For medical and specialty gas piping specialties to include in emergency, operation, and maintenance manuals.

1.7 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. Laboratory valve and nozzle.
 - a. Natural gas: Equal to 10 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Medical Gas Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
 - 2. Bulk Medical Gas Systems for Healthcare Facilities: According to ASSE Standard #6015 for bulk-medical-gas-system installers.
 - 3. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Medical carbon dioxide operating at 0.5 to 2 psig.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Medical gas manifolds shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the medical gas manifolds will remain in place without separation of any parts when subjected to the seismic forces specified and the manifolds and tanks will be fully operational after the seismic event."
 - 2. Component Importance Factor is 1.5.

2.3 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical gas piping materials.
- B. Copper Medical Gas Tube: ASTM B 819, Type K and Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service; or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
- C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
- D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch -maximum thickness, full-face type.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- F. Shape-Memory-Metal Couplings:
 - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Aerofit, Inc.
 - b. Smart Tap, Inc.
 - 3. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.
- C. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.5 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
 - 1. Zone-Valve Boxes:
 - a. Steel Box with Aluminum Cover:

- 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2) Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a) Allied Healthcare Products Inc.
 - b) Amico Corporation.
 - c) Ohio Medical Corporation.
 - d) Patton's Medical
- b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
- 1) Interior Finish: Factory-applied white enamel.
 - 2) Cover Plate: Aluminum with frangible or removable windows.
 - 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. BeaconMedaes.
 - d. Conbraco Industries, Inc.
 - e. Marwin Valve; a division of Richards Industries.
 - f. NIBCO INC.
 - g. Ohio Medical Corporation.
 - h. Tri-Tech Medical Inc.
 - i. Patton's Medical
3. Standard: MSS SP-110.
4. Description: Three-piece body, brass or bronze.
5. Pressure Rating: 300 psig minimum.
6. Ball: Full-port, chrome-plated brass.
7. Seats: PTFE or TFE.
8. Handle: Lever[type with locking device].
9. Stem: Blowout proof with PTFE or TFE seal.
10. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
11. Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet."
12. Inlet: Manufacturer-installed, NPS 1 or NPS 1-1/4, ASTM B 819, copper tubing with NPS 1 minimum ball valve.
13. Safety Valve: Bronze-body pressure relief valve set at 75 or 80 psig.
14. Instrumentation: Pressure gage.

D. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

2.6 MEDICAL GAS SERVICE CONNECTIONS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide lab type wall mounted valve with flange and laboratory 10 serration nozzle compatible outlets by one of the following:
1. Amico Corporation.
 2. Chicago Faucets.
- B. General Requirements for Medical Gas Service Connections:
1. Suitable for specific medical gas pressure and suction service listed.
 2. Include roughing-in assemblies, finishing assemblies, and cover plates.
 3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
 4. Recessed-type units made for concealed piping unless otherwise indicated.
- C. Roughing-in Assembly:
1. Steel outlet box for recessed mounting and concealed piping.
 2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.
 3. Double seals that will prevent gas leakage.
 4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.
- D. Finishing Assembly:
1. Brass housing with primary check valve.
 2. Double seals that will prevent gas leakage.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if pre-cleaned fittings or tubing must be re-cleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
 2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of medical gas piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- H. Install piping to permit valve servicing.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and for branch connections.
- K. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
- L. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- M. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- N. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
- O. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
- B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on gas piping where reduced pressure is required.
- F. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.

3.4 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- B. Threaded Joints: Apply appropriate tape to external pipe threads.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.
- D. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 GAS SERVICE COMPONENT INSTALLATION

- A. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.
- B. Install nitrogen pressure-control panels in walls. Attach to substrate.
- C. Install gas manifolds anchored to substrate.
- D. Install gas cylinders and connect to manifold piping.
- E. Install gas manifolds with seismic restraints.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 3/4: 84 inches with 3/8-inch rod.
 - 4. NPS 1: 96 inches with 3/8-inch rod.
 - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
 - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
 - 7. NPS 2: 11 feet with 3/8-inch rod.
 - 8. NPS 2-1/2: 13 feet with 1/2-inch rod.
 - 9. NPS 3: 14 feet with 1/2-inch rod.
 - 10. NPS 3-1/2: 15 feet with 1/2-inch rod.
 - 11. NPS 4: 16 feet with 1/2-inch rod.
 - 12. NPS 6: 20 feet with 5/8-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.

3.7 IDENTIFICATION

- A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Carbon Dioxide: Black or white letters on gray background.
 - 2. Nitrogen: White letters on black background.

3. Nitrous Oxide: White letters on blue background.
4. Oxygen: White letters on green background or green letters on white background.

3.8 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
 2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blowdown.
 - b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for positive-pressure medical gas piping.
 - f. Standing pressure test for vacuum systems.
 - g. Repair leaks and retest until no leaks exist.
 3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 - a. Standing pressure test.
 - b. Individual-pressurization or pressure-differential cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Piping particulate test.
 - g. Piping purity test.
 - h. Final tie-in test.
 - i. Operational pressure test.
 - j. Medical gas concentration test.
 - k. Medical air purity test.
 - l. Verify correct labeling of equipment and components.
 - m. Verify medical gas supply sources.
 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.
- D. Prepare test and inspection reports.

3.9 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect specialty gas regulators for proper operation.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.
- D. Prepare test and inspection reports.

3.10 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.11 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain bulk gas storage tanks.

3.12 PIPING SCHEDULE

- A. Connect new tubing to existing tubing with memory-metal couplings.

3.13 VALVE SCHEDULE

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION

SECTION 226710 - PURE WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pure water piping.

1.3 DEFINITIONS

- A. PP: Polypropylene plastic.
- B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Deionized (Reagent grade) Water Piping: 150 psig unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of pipe and fitting indicated.
- B. Welding certificates.
- C. Samples of field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
- B. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. ASME Compliance: Comply with ASME B31.3, "Process Piping."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe and fittings from dirt and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
- B. Transition Fittings: Couplings, flanges, or other manufactured fittings, same size as, with pressure rating at least equal to and ends compatible with piping to be joined.

2.3 PLASTIC PIPE AND FITTINGS

- A. Schedule 80, CPVC Pipe and Fittings: Ultra-pure piping and fittings are to be low extractable CPVC with a Cell classification of 12343 per ASTM D1784, Schedule 80 with a type II pressure rating.
 - 1. Manufacturers:
 - a. Spears LXT

2.4 PLASTIC VALVES

- A. CPVC Valves: Made from ASTM D 1784, CPVC compounds.
 - 1. Ball Valves, NPS 2 and Smaller: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig at 73 deg F.
 - 2. Check Valves: Swing or ball type with pressure rating not less than 150 psig at 73 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to and of material same as, or compatible with, piping may be used in applications in this article, unless otherwise indicated.
- B. Pure -Water Piping: Use the following piping materials for each size range:

1. Spears Schedule 80 LXT CPVC pipe and fittings and glued joints.
2. Piping running in the plenum shall be wrapped with an approved fire wrap to meet the fire and smoke requirements of the plenum.

3.2 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirement apply:
 1. Shutoff Duty: Use ball valves.
 2. Throttling Duty: Use ball valves.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of deionized-water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- C. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for general piping installation requirements.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction. Where specific joint construction is not indicated, follow piping manufacturer's written instructions. Join in accordance with manufacturers recommendations.
- B. Joint dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

3.4 VALVE INSTALLATION

- A. Refer to Division 23 Section "Valves" for general valve installation requirements.
- B. Install sectional valves close to mains on each branch and riser serving equipment.
- C. Install shutoff valve on each supply to equipment.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls."
- B. Pipe hanger and support devices and installation requirements are specified in Division 22 Section "Hangers and Supports." Install the following:
 1. Clamps for Vertical Piping: MSS Type 8 or Type 42.
 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

- c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
- 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.
- F. Install padded hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 36 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 42 inches with 3/8-inch rod.
 - 3. NPS 2-1/2 to NPS 3-1/2: 48 inches mm with 1/2-inch rod.
 - 4. NPS 4 and NPS 5 and DN 125: 48 inches with 5/8-inch rod.
 - 5. NPS 6: 48 inches with 3/4-inch rod.
 - 6. NPS 8: 48 inches with 7/8-inch rod.
- G. Install padded supports for vertical PVC piping every 48 inches.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect deionized-water piping to equipment and service outlets with unions or flanges.

3.7 LABELING AND IDENTIFICATION

- A. Install pipe markers and valve tags on piping. Distinguish between different systems and include direction of flow indication on each pipe. Labeling and identification devices are specified in Division 22 Section "Mechanical Identification."

3.8 FIELD QUALITY CONTROL

- A. Test new piping and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.
 - 1. Schedule tests and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
 - 2. Do not cover or put into service before inspection and approval.
 - 3. Test completed piping according to authorities having jurisdiction. If authorities having jurisdiction do not have published procedures, perform tests as follows:

- a. Hydrostatic Tests: Test piping at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.
 - b. Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.
4. Replace leaking joints with new materials and retest until no leaks exist.
 5. Submit separate reports for each test.

3.9 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Clean piping by flushing with system deionized water.

END OF SECTION

SECTION 230100 - MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 01, and herewith made a part of this Division.
- B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.
- C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warranties and guarantees as if the Mechanical Contractor had purchased the equipment.
- D. Construction Indoor-Air Quality Management
 - 1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 - a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - b. Replace all air filters immediately prior to occupancy.
 - 2. Comply with one of the following requirements:
 - a. After Construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. Ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
 - b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

1.2 SCOPE OF WORK

- A. The project described herein is HCI Level 3 Lab Remodel. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.

1.3 CODES & ORDINANCES

- A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.
- B. Applicable codes:
1. International Building Code- 2021 Edition
 2. International Mechanical Code- 2021 Edition
 3. International Plumbing Code- 2021 Edition
 4. International Fire Code- 2021 Edition
 5. ASHRAE Standard 90.1 - 2022 Edition
 6. International Fuel Gas Code- 2021 Edition
 7. National Electrical Code- 2020 Edition
 8. ASHRAE Standard 62.1 – 2022 Edition
 9. ASHRAE Standard 170 – 2021 Edition

1.4 INDUSTRY STANDARDS

- A. All work shall comply with the following standards.
1. Associated Air Balance council (AABC)
 2. Air Conditioning and Refrigeration Institute (ARI)
 3. Air Diffusion council (ADC)
 4. Air Movement and Control Association (AMCA)
 5. American Gas Association (AGA)
 6. American National Standards Institute (ANSI)
 7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
 8. American Society of Mechanical Engineers (ASME)
 9. American Society of Testing Materials (ASTM)
 10. American Water Works Association (AWWA)
 11. Cooling Tower Institute (CTI)
 12. ETL Testing Laboratories (ETL)
 13. Institute of Electrical and Electronic Engineers (IEEE)
 14. Hydronics Institute (HI)
 15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
 16. National Fire Protection Association (NFPA)
 17. National Electrical Code (NEC)
 18. National Electrical Manufacturers Association (NEMA)
 19. National Electrical Safety code (NESC)
 20. Utah safety Standard (OSHA), Utah State Industrial Council.
 21. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 22. Underwriters Laboratories (UL)
 23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
 24. Heat Exchanger Institute (HEI)
 25. Hydraulic Institute (HI)
 26. Thermal Insulation Manufacturer=s Association (TIMA)
 27. Scientific Apparatus Makers Association (SAMA)
- B. Compliance Verification:

1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer's data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

- A. All fees for permits required by this work will be paid by this division with the understanding that any fees that are required to be paid will be reimbursed by the owner. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

1.6 SUBMITTALS AND SHOP DRAWINGS

- A. General: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect manufacturer's data on products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineer's office to which the project is being constructed from. If the Contractor's schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. If the re-submittal is returned a 2nd time for correction the Contractor will provide the specific equipment that is specified on the drawings and/or the specifications. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project.
- B. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.
- C. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.
- D. Submittal Format: At the contractor's discretion, project submittals may be in either of the formats described in the following paragraphs, but mixing the two formats is not acceptable.
 1. Electronic Submittal Format: Identify and incorporate information in each electronic submittal file as follows:

- a. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
- b. Submitted electronic file shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
- c. Submitted electronic file shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
- d. Submitted electronic file shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
- e. 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.
- f. Name file with submittal number or other unique identifier, including revision identifier.
- g. Electronic file shall be completely electronically searchable or it will be rejected.
- h. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by:
 - 1) Architect.
- i. Transmittal Form for Electronic Submittals:
 - 1) Use one of the following options acceptable to the Owner;
 - a) Software-generated form from electronic project management software.
 - b) Electronic form.
 - 2) The Electronic Submittal shall contain the following information:
 - a) Project name.
 - b) Date.
 - c) Name and address of Architect.
 - d) Name of Construction Manager.
 - e) Name of Contractor.
 - f) Name of firm or entity that prepared submittal.
 - g) Names of subcontractor, manufacturer, and supplier.
 - h) Category and type of submittal.
 - i) Submittal purpose and description.
 - j) Specification Section number and title.
 - k) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l) Drawing number and detail references, as appropriate.
 - m) Location(s) where product is to be installed, as appropriate.
 - n) Related physical samples submitted directly.
 - o) Indication of full or partial submittal.
 - p) Transmittal number[, numbered consecutively].
 - q) Submittal and transmittal distribution record.
 - r) Other necessary identification.
 - s) Remarks.

- j. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - 1) Project name.
 - 2) Number and title of appropriate Specification Section.
 - 3) Manufacturer name.
 - 4) Product name.

- E. Submittal Requirements - Submittals MUST be compiled in PDF format, organized, properly labeled with specification sections, and book marked.
 - 1. Mail physical samples to Archer Mechanical 2745 W. California Ave., Salt Lake City, UT 84104
 - 2. Submittal files larger than 25MB must be delivered to the Archer Mechanical office via thumb drive.
 - 3. Subcontractor/Vendor markups should be purple. GC markups will be blue, architect markups will be red, and consultant markups will be green. Any variations of sizing and/or performance shall be clearly indicated with an explanation of variation.
 - 4. Submittals must be submitted no later than two weeks from notice.
 - 5. Partial submittals will not be accepted. All required test data, certifications, qualification data, schedules, shop drawings, test reports, etc. must be included.
 - 6. Substitutions not previously accepted will not be allowed in submittals.
 - 7. All clarifications and questions about scope of work must be submitted in RFI(s) rather than in submittals
 - 8. Specific schedule of lead times for all items that are not 'off the shelf' must be submitted within 10 days of NTP. (See schedule requirements)

1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.

- B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.

- C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.

- D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.

- E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.

- F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.
- G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

- A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

1.9 EXISTING CONDITIONS

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.
- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.
- D. Any HVAC system that is modified shall be rebalanced and recommissioned additional requirements. If the unit modified serves more than the area under the current scope of work, the entire area served by that unit must be re-balanced and recommissioned.

1.10 EQUIPMENT CAPACITIES

- A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.
- B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

- A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.
- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

1.13 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.
- B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

- A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.
- B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

- A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

- A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.
- B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.
- C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.

- D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

- A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.
- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.
- C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.
- D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.
- E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.
- B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.

- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

- A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.
- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.
- C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 EXCAVATION AND BACKFILLING

- A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.
- B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

1.25 ACCESS

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to

Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. . If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910

- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.
- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.
- E. Fans with 3 HP and above, which are elevated such that the distance from floor to any maintenance point is 6-foot or higher, shall have an appropriate access platform with permanent ladders or steps designed and shown on the design drawings.
- F.

1.26 CONCRETE BASES AND INSERTS

- A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 03, Concrete.
- B. All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.
- C. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division
- D. Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

1.27 CLEANING AND PAINTING

- A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere,

caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

- B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 09, Exterior and Interior Painting.
- C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.
- D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.28 CONTRACT COMPLETION

- A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.
- B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
- C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.
- D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.
- E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
 - 1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
 - 2. That the circulation of water shall be complete and even.
 - 3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
 - 4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.

5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.
7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.29 CURBS

- A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23.

1.30 TEST RUN

- A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

1.32 DEMOLITION

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

- C. 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.
- D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- E. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
- F. Maintain adequate ventilation when using cutting torches.
- G. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- J. Dispose of demolished items and materials promptly.
- K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- L. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- M. 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.
- N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

END OF SECTION

SECTION 230150 - TEMPORARY USE OF EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes requirements for temporary use of equipment and systems and any other items that are used during the construction of the project.

1.2 EQUIPMENT OR SYSTEMS NEEDED TO OPERATE BEFORE CONTRACT COMPLETION

- A. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly for start up and or to meet the project schedule the guaranteed of all systems and equipment shall be for one year from the date of the Architect's Certificate of Substantial Completion.

All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any contractor or equipment supplier who is not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the systems and all items of equipment for this period.

All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.

If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean. All return air openings shall be protected with a metal filter frame and filters.

1.3 TEMPORARY EQUIPMENT OR SYSTEM SUBMITTALS

- A. If it is determined by the project or contractor that equipment or systems are needed to operate to provide heating, cooling or other needed services this division shall submit a document indicating what measures will be taken to insure the safe and proper operation of the equipment, systems and personal associated with the operation, this document shall be submitted to the engineer for approval. This plan shall show connections of equipment, utility hookups (if required) staging areas etc.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- D. SMACNA: The latest standard from SSMACNA shall apply.

1.5 PROJECT CONDITIONS

- A. Temporary Use of equipment or systems: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use until the facility has been accepted by the owner regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 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 and cooling units if required with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filters with MERV of 8 at each return air opening in system and remove at end of construction. These filters are to be installed in a filter housing frame and are not to be duct taped. Clean HVAC system as required in Division 01 Section "Closeout Procedures."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate equipment where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify equipment and systems as required by progress of the Work.
 - 1. Locate equipment to limit site disturbance as specified in Division 01 Section "Summary."

3.2 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: Install water service and distribution piping in sizes and pressures adequate for construction.
- C. 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.
- D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

3.3 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain equipment and systems in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar equipment and systems on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Termination and Removal: Remove each temporary facility or equipment 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 equipment that constitute temporary equipment are property of Contractor.
 - 2. At Substantial Completion, repair, renovate, and clean permanent equipment and systems used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

3.4 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer at substantial completion. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.

END OF SECTION

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 1. Piping materials and installation instructions common to most piping systems.
 2. Transition fittings.
 3. Dielectric fittings.
 4. Equipment installation requirements common to equipment sections.
 5. Painting and finishing.
 6. Concrete bases.
 7. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspace.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases, and accessible tunnels.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. CPVC: Chlorinated polyvinyl chloride plastic.
 2. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BA91, silver alloy for refrigerant piping, unless otherwise indicated.
 - 1. Use of flux is required in all brazing applications. The flux used is to be a black brazing flux that does not contain boric acid and conforms to AWS A5.31 class FB3-C.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.

2.5 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Watts Industries, Inc.; Water Products Div

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8 & a black brazing flux that does not contain boric acid complying with AWS A5.31 class FB3-C.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 LINK SEAL

- A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION

SECTION 230550 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All pertinent sections of Division 21, 22, & 23 Mechanical General Requirements, are part of the work of this Section. Division 01 is part of this and all other sections of these specifications.
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC".
 - 2. Division 23 Section "Mechanical Requirements" for Training and Instructions to Owner's Representative.

1.2 SCOPE OF WORK

- A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 01).
- B. Coordination of work required for system commissioning.
- C. Provide a hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format.

1.3 SUBMITTALS

- A. Submit product data in accordance with Division 01 and Division 23 Section "Mechanical Requirements". Submit the following:
 - 1. Sample of O and M manual outline.

PART 2 - PRODUCTS

2.1 O & M MANUALS

- A. The operating and maintenance manuals shall be as follows:
 - 1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with Division 01)

OPERATING AND MAINTENANCE
MANUAL
FOR THE

(INSERT PROJECT NAME)

(INSERT PROJECT COMPLETION YEAR)

VOLUME No. ()

VAN BOERUM & FRANK ASSOCIATES, INC.
MECHANICAL ENGINEER

(INSERT ARCHITECT)

Binders shall be a manufactured by:

We R Memory Makers
631 North 400 West
Salt Lake City, Utah 84103
801-539-5000

PART 3 - EXECUTION

3.1 OPERATING AND MAINTENANCE MANUALS:

- A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.
- B. The "Start-Up and Operation" section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step-by-step start-up procedure shall be described.
- C. The manuals shall include air and water-balancing reports, system commissioning procedures, start-up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner's representatives.
- D. American Society of Mechanical Engineers (ASME) Stamp shall be required on all items required by code or specified to conform to the ASME Code, and certificates will be included in the O&M manuals.
- E. Form U-1, the manufacturers' data report for pressure vessels, is to be included in the operation and maintenance manuals. National Board Register (NBR) numbers shall be provided where required by code, and included in the manuals.
- F. Underwriters Laboratories (UL) or equivalent ETL labels shall be applied to manufactured equipment represented by a UL classification and/or listing. Included certification in the O&M manuals.

An index sheet typed on AICO Gold-Line indexes shall be provided in the front of the binder. The manual shall be include the following:

SYSTEM DESCRIPTIONS

START-UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION, INTERLOCK
AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR AND WATER SYSTEM BALANCING REPORTS

EQUIPMENT WARRANTIES AND TRAINING CERTIFICATES

SYSTEM COMMISSIONING REPORTS

EQUIPMENT START-UP CERTIFICATES

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - c. Primary-secondary hydronic systems.
 - 3. Balancing Steam Systems.
 - 4. Various HVAC Equipment.
 - a. Heat Exchangers.
 - b. Motors.
 - c. Chillers.
 - d. Cooling Towers.
 - e. Condensing Units.
 - f. Boilers.
 - g. Heat Transfer Coils.
 - 5. Domestic Heater Systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within the following number of days of the Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article;

1. 30 days.

B. Certified TAB reports.

C. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB and shall be the same as the TAB Contractor.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician and shall be the same as the TAB Contractor.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by:

1. Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on the following distribution systems have been satisfactorily completed:
 - 1. Air and water.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. BTC Service.
 - 2. Certified Test & Balance.
 - 3. RS Analysis.

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine:
 - 1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
 - a. Division 23 Section "Metal Ducts"
 - 2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
 - 3. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in this section and:
 - 1. AABC's "National Standards for Total System Balance"
 - 2. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "Duct Insulation," Division 23 Section "HVAC Equipment Insulation," and Division 23 Section "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) .

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from one of the following entities for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance:
 - a. Architect.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Division 23 Section "Hydronic Pumps."
 - 1) Architect.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.12 PROCEDURES FOR STEAM SYSTEMS

- A. Measure and record upstream and downstream pressure of each piece of equipment.
- B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
- C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- D. Check settings and operation of each safety valve. Record settings.
- E. Verify the operation of each steam trap.

3.13 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.

- E. Check settings and operation of safety and relief valves. Record settings.

3.14 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Motor balanced frequency and the date & time it was balanced.
6. Drive kW.
7. Drive torque.
8. Nameplate and measured voltage, each phase.
9. Nameplate and measured amperage, each phase.
10. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.15 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.16 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.

6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.17 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.18 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Airflow.
 3. Air pressure drop.
 4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressure drop.
 5. Refrigerant suction pressure and temperature.

3.19 DOMESTIC HEATER SYSTEMS

- A. Test domestic heater system per Engineer's instructions.

3.20 AIRBORNE INFECTIOUS ISOLATION (AII) & PROTECTIVE ENVIRONMENT (PE) ROOMS

- A. After construction has been completed, but prior to occupancy in these rooms the TAB contractor is to measure, adjust, record, and report the following data for each AII or PE room:
1. Supply airflow.
 2. Return airflow.
 3. Exhaust airflow.
 4. Room pressure relative to adjacent spaces.
 5. Prove that the room will maintain either a positive or negative 0.03-inch WC pressure differential, depending on the room's pressure requirement as called for by the design engineer.
 6. Proper operation of room controls.
 7. Functionality of pressure monitors & alarms.

3.21 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.22 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports on the following interval to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors;
1. Weekly.

3.23 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.

2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in inches, and bore.
- i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.

- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.
- h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

- a. System and air-handling-unit number.
- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft..
- g. Indicated air flow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual air flow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.

- h. Size.
 - i. Effective area in sq. ft..
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.24 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by:
 - a. Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of:
 - a. Architect.
3. The following entity shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day:
 - a. Architect.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.25 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 26 0500 - ELECTRICAL GENERAL PROVISIONS
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

1.2 DESCRIPTION OF WORK:

- A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items.

	<u>ITEM</u>	<u>SECTION</u>
1.	Electrical General Provisions	26 0500
2.	Electrical Submittals and Spare Parts	26 0502
3.	Electrical Connections for Equipment	26 0507
4.	Conductors and Cables (600V and Below)	26 0519
5.	Grounding	26 0526
6.	Supporting Devices	26 0529
7.	Conduit Raceway	26 0532
8.	Electrical Boxes and Fittings	26 0533
9.	Raceway Systems	26 0536
10.	Electrical Seismic Control	26 0548
11.	Electrical Identification	26 0553
12.	Occupancy Sensors	26 0923
13.	Lighting Control Equipment	26 0943
14.	Wiring Devices	26 2726
15.	Overcurrent Protective Devices	26 2815
16.	Demolition	26 4119
17.	Interior and Exterior Building Lighting	26 5100
18.	Telephone Data Systems	27 1500
19.	Voice Evacuation Fire Alarm and Detection System	28 3111

- B. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and systems required as a portion of this work.
- C. Visit the site during the bidding period to determine existing conditions affecting electrical and other work. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.3 DEFINITION OF TERMS

- A. The following terms used in Divisions 26, 27 and 28 documents are defined as follows:
1. "Provide": Means furnish, install and connect, unless otherwise indicated.
 2. "Furnish": Means purchase and deliver to project site.
 3. "Install": Means to physically install the items in-place.
 4. "Connect": Means make final electrical connections for a complete operating piece of equipment.

1.4 RELATED SECTIONS:

- A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
- B. General and Supplementary Conditions: Drawings and general provisions of contract and Division 1 of the Specifications, apply to all Division 26, 27 and 28 sections.
- C. Miscellaneous Metal Work:
1. Provide fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor controls centers, etc. See Division 5, Metals for material and installation requirements.
- D. Miscellaneous Lumber and Framing Work:
1. Provide wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. See Division 6, Rough Carpentry for material and installation requirements.
- E. Moisture Protection:
1. Provide membrane clamps, sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors and ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight. See Division 7, Thermal and Moisture Protection for material and installation requirements.
- F. Access panels and doors:
1. Provide in walls, ceiling, and floors for access to electrical devices and equipment. See Division 8, Doors and Windows for material and installation requirements.
- G. Painting:
1. Provide surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, poles, surface metal raceways, etc. See Division 9, Finishes for material and installation requirements.

1.5 WORK FURNISHED AND INSTALLED UNDER ANOTHER SECTION REQUIRING CONNECTIONS UNDER THIS SECTION:

- A. Provide electrical service, make requisite connections and perform operational test. Items furnished and installed under other sections and connected under this section, include but are not limited to the following:

1. Laboratory equipment including hoods, cold rooms, autoclaves, drying ovens, glassware washers and dryers, refrigerators, freezers, etc.
2. Systems/Open Office Furniture

1.6 ITEMS FURNISHED UNDER ANOTHER DIVISION, BUT INSTALLED AND CONNECTED UNDER THIS DIVISION:

- A. Items furnished under other Divisions, but turned over to Division 26 for installation and final connection include, but are not necessarily limited to, the following:
1. Lighting fixtures, receptacles, and switches for fume hoods.

1.7 WORK NOT INCLUDED IN THIS DIVISION:

- A. Items of work provided under another contract include, but are not necessarily limited to, the following:
1. Telephone electronic equipment.
 2. Data system electronic equipment.
 3. Control wires for irrigation control valves.
 4. Energy management/temperature control system; both line and low voltage including conductors and conduit.
 5. Television monitors and projection equipment.
 6. Security system equipment, cables, fittings, and coverplates.
 7. CCTV cabling and electronic equipment.
 8. MATV cabling and electronic equipment

1.8 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:

- A. Before bidding, Contractor shall familiarize himself with the drawings, specifications and project site. Submit requests for clarification to Architect/Engineer in writing prior to issuance of final addendum. After signing the contract, the Contractor shall meet the intent, purpose, and function of the Contract Documents. Any costs of materials, labor and equipment arising therefrom, to make each system complete and operable, is the responsibility of the Contractor.

1.9 REQUESTS FOR INFORMATION (RFIs):

- A. Contractor shall review all Contract Documents thoroughly before submitting an RFI to avoid unnecessary questions and ensure the question has not already been addressed within the existing Contract Documents.
- B. RFIs should be used to seek clarification on issues or areas of confusion that cannot be resolved through a review of the Contract Documents.
- C. Each RFI shall contain the following:
1. Description of the Issue/Question: Clearly detail the issue or confusion, referencing the related Contract Document drawings and/or specifications.
 2. Relevant Documents: Attach any necessary supporting documents that could aid in understanding the RFI.

3. Proposed Solution: Suggest a possible resolution to the problem or confusion.
- D. Non-Compliant RFIs
1. Frivolous or incomplete RFIs will not be accepted. RFIs that do not follow the guidelines set forth in this section, or are deemed unnecessary, may be returned without response at the discretion of the Engineer.

1.10 QUALITY ASSURANCE:

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies refers to the latest edition of such publications adopted and published prior to submittal of the bid proposed, unless noted otherwise herein. Such codes or standards are considered a part of this specification as though fully repeated herein.
- B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred as reducing the quality, requirements or extent of the Drawings and Specifications. Perform work in accordance with applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:
1. National Electric Code (NEC).
 2. International Building Code (IBC).
 3. International Fire Code (IFC).
 4. International Mechanical Code (IMC).
- C. Standards: Comply with the following standards where applicable for equipment and materials specified under this Division.
- | | | |
|----|-------|--|
| 1. | UL | Underwriters' Laboratories |
| 2. | ASTM | American Society for Testing Materials |
| 3. | CBN | Certified Ballast Manufacturers |
| 4. | IPCEA | Insulated Power Cable Engineers Association |
| 5. | NEMA | National Electrical Manufacturer's Association |
| 6. | ANSI | American National Standards Institute |
| 7. | ETL | Electrical Testing Laboratories |
- D. All electrical apparatus furnished under this Section shall conform to (NEMA) standards and the NEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.
- E. Comply with requirements of State and Local Ordinances. If a conflict occurs between these requirements and the Contract Documents, the most stringent requirements shall govern. The Contractor accepts this responsibility upon submitting his bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the Contract Documents that may be in excess of the aforementioned requirements, and not contrary to same.
- F. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.
- G. Employ only qualified craftsmen with at least three years of experience. Workmanship shall

be neat, have a good mechanical appearance and conform to best electrical construction practices. Provide a competent superintendent to direct the work at all times. Any person found incompetent shall be discharged from the project and replaced by satisfactory personnel.

- H. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

1.11 CONSTRUCTION CHANGE ORDER PROPOSALS

- A. In the event that a submission of a change order is issued by the contractor, the following information will be required to be submitted by the contractor, prior to any consideration by the owner/architect.
 - a. Where project manager or project engineer work is required, the labor cost shall not exceed 2% of the electrical portion of the change order.
 - b. All equipment, including conduit and wire, shall be itemized, identifying unit costs and quantities of equipment. Distributor quotes shall accompany all change order requests. The distributor quotes shall include costs for all equipment including conduit and wire. Lot pricing for equipment is not acceptable.
 - c. The general contractor shall review and confirm that the quantity and costs of materials submitted appear reasonable for the scope proposed.
 - d. Labor units shall not exceed base NECA #1 standards. No adjustment factors shall be approved.
 - e. Any research and labeling time, shall be the responsibility of the electrical contractor and shall not be included in the change order request.
 - f. Any costs associated with the purchase of tools or transportation shall be fully itemized for review by architect/owner.
 - g. Overtime rates shall only be approved where additional manpower cannot achieve the same result.
 - h. Change order form shall follow the following format:
 - i. PCO number
 - ii. Detailed description of work being performed
 - iii. Location on project where work is performed
 - iv. Chosen NECA column
 - v. Identified material:
 - 1. QTY
 - 2. Unit cost
 - 3. Mark up
 - 4. Material total
 - vi. Identified labor:
 - 1. QTY
 - 2. Unit cost
 - 3. Composite labor rate
 - 4. Labor total

1.12 RECORD DRAWINGS:

- A. Contractor shall provide as-built drawings and a record model of the completed project, reflecting all deviations from the original design including but not limited to field conditions, RFIs, ASIs, and other modifications. The as-built drawings shall be provided in both Autodesk Revit and PDF formats.

- B. Maintain, on a daily basis, a complete set of "Record Drawings", reflecting an accurate record of work in accordance with the following:
 - 1. Show the complete routing and location of all feeders rated 100 amps and larger. Contractor shall clearly indicate dimensions on the drawings for work that is hidden beneath the ground or under slabs, concealed above ceiling structures, and within concealed spaces. These dimensions shall be measured from fixed structural elements, rather than from partition walls or other non-structural elements.
 - 2. Show the complete routing and location of all telecommunications conduits, systems raceways, and empty raceways, 1-1/4" and larger. Contractor shall clearly indicate dimensions on the drawings for work that is hidden beneath the ground or under slabs, concealed above ceiling structures, and within concealed spaces. These dimensions shall be measured from fixed structural elements, rather than from partition walls or other non-structural elements.
 - 3. Show all changes, deviations, addendum items, change orders, job instructions, etc., that change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.
 - 4. Provide a copy of the raceway as-builts within the equipment rack for the system indicated below. Provide 11x17 size laminated prints that are legible.
 - a. Telecommunications
 - b. Audiovisual
- C. At the discretion of the Architect/Engineer, the drawings will be reviewed on a periodic basis and used as a pre-requisite for progress payments. This requirement shall not be construed as authorization for the Contractor to make changes in the layout, or work without written authorization for such changes.
- D. The Architect/Engineer shall review the drawings and the Contractor shall incorporate the resulting comments into the final record drawings.
- E. Certify the "Record Drawings" for correctness by placing and signing the following certifications of the first sheet of the drawings:

"CERTIFIED CORRECT (3/8" high letters)

(Name of General Contractor)

By: _____ Date: _____

(Name of Electrical Contractor)

By: _____ Date: _____

1.13 GUARANTEE:

- A. Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes. Without additional

charge, replace any work or materials that develop defect, except from ordinary wear and tear, within one year from the date of substantial completion. Exception: Incandescent and fluorescent lamps shall be guaranteed for a period of two months from the date of substantial completion.

1.14 OTHER:

- A. Right to Hire. "Client" agrees that during the project and for a period of twenty four (24) months following substantial completion that it will not, directly or indirectly, employ or solicit to employ BNA Personnel.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Products are specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

2.2 MANUFACTURERS:

- A. Provide products of manufacturers specified. Manufacturers catalog numbers and descriptions establish the quality of product required. Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Architect/Engineer eight (8) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.
- B. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.
- C. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.
- D. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.
- E. Provide only equipment specified in the Contract Documents or approved by addendum.

2.3 SPARE PARTS:

- A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting structural members shall not be permitted.
- B. Provide equipment enclosures appropriate to the environment to which they are installed. For example, provide NEMA 3R for exterior enclosures and NEMA 1 for interior enclosures unless otherwise noted.
- C. Since the drawings of floor, wall, and ceiling installation are made at small scale; outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings, but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.
- D. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc., or from being located in chalkboards, tackboards, glass panels, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.
- E. Coordinate the location of outlets, devices, connections, and equipment with the supplier of the systems furniture prior to rough-in.
- F. Where conduit, outlets or apparatus are to be encased in concrete, it must be located and secured by a journeyman or foreman present at the point of installation. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.
- G. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

3.2 CLEAN:

- A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.
- B. Clean fixtures, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

3.3 POWER OUTAGES:

- A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the Owner. Include all costs for overtime work in bid.

- B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.
- C. Keep all outages to an absolute minimum.

3.4 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.5 FIRE PENETRATION SEALS:

- A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. The fire rating of the penetration seal shall be at least that of the floor, wall or ceiling that it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs, and similar structures. Where applicable, provide 3M CID cast-in device for floor slabs. Where applicable, provide 3M fire barrier sealing penetration system, and/or IPC Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps, and other accessories as required. All materials to comply with UL 1479 (ASTM E-814). Comply with manufacturer's instructions and recommendations for installation of sealing fittings and barrier sealing systems.

3.6 PROJECT FINALIZATION AND START-UP:

- A. Upon completion of equipment and system installation, assemble all equipment Factory Representatives and Subcontractors for system start-up.
- B. Each Representative and Subcontractor shall assist in start-up and check out their respective system and remain at the site until the total system operation is accepted by the Owner's representative.
- C. The Factory Representative and/or System Subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:
 - 1. This is to certify that the Factory Representative and System Subcontractor for each of the systems listed below have performed start-up and final check out of their respective systems.
 - 2. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system.

SYSTEM

FACTORY REPRESENTATIVE

(List systems included)

(List name and address of Factory Representative)

Owner's Representative Contractor

D. Send copy of acceptance to Architect/Engineer.

3.7 FINAL REVIEW:

A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

END OF SECTION 26 0500

SECTION 26 0502 - ELECTRICAL SUBMITTALS, O & M MANUALS AND SPARE PARTS
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to all Division 26, 27 and 28 sections.
- B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.
- C. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 SUBMITTAL REQUIREMENTS:

A. GENERAL:

- 1. After the Contract is awarded but prior to ordering, manufacture, or installation of any equipment, prepare complete Submittals including shop drawings, product data, brochures, etc. for materials and equipment as required by each section of the specification.
- 2. Review of Submittals shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Document's shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.
- 3. Submittals are reviewed, not approved. Comments made within submittals do not alter the contract documents in any way. The contractor is still responsible, regardless of comments (if any) made within submittals, for complying with drawings and specifications.
- 4. Notify engineer in writing if any of the comments noted in the submittals alter the contract cost. A comment within the submittal process which increases/decreases cost of product is not an authorization to the contractor under any circumstances to proceed.
- 5. Notify engineer of any modifications between contract documents and submittals. It is the responsibility of the contractor to ensure compliance.
- 6. ELECTRONIC SUBMITTAL REQUIREMENTS:
 - a. Provide submittals in Portable Document Format (PDF).
 - b. Documents must be electronically bookmarked by Division e.g. 26, 27 and 28, Specification section e.g. 26 0510 and individually for each item submitted for light fixtures, switchgear, transformer, panelboard etc. and keyword searchable using Adobe Acrobat

(<http://www.adobe.com/acrobat>) or Bluebeam Revu (<http://www.bluebeam.com>) for each relevant section.

- c. Electronically highlight all options for light fixtures, electrical equipment, etc. Manual highlighting and scanning of the documents is NOT acceptable and will NOT be reviewed.
- d. Provide only completed cutsheets for all fixture and equipment types. Blank cutsheets submitted with a schedule are NOT acceptable and will NOT be reviewed.
- e. At the time of submission, the electrical contractor shall provide a complete and comprehensive submission of all required specification sections/shop drawings at the same time. Exceptions may be given, with prior approval, for time-sensitive equipment.
- f. A maximum of one submittal per specification section is allowed. It is NOT acceptable to provide a product by product submittal. Single product by product submittals will NOT be reviewed.

B. SCHEDULING

1. GENERAL

- a. A minimum period of two weeks, exclusive of transmittal time, will be required each time Submittals are submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling submittal data.
- b. If the shop drawings are rejected twice, the contractor shall reimburse the engineering firm the sum of \$1,200.00 for the third review and any additional reviews required prior to the commencement of additional review.

C. QUALITY ASSURANCE

1. PRE-SUBMITTAL PREPARATION

- a. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to ensure proper clearance for installation of equipment.
- b. Shop drawings requiring the use of electronic documents (floor plans, Lighting plans, fire alarm plans, etc.) shall be requested via a request for information (RFI) through the general contractor. Electronic documents will be provided to the Architect for distribution. No direct vendor requests will be accepted.
- c. Contractor is completely responsible for the content of the submittal

2. SUBMITTAL REQUIREMENTS

- a. Provide a stamp or statement on each submittal as follows:
 - i. I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Drawings and Specifications for this Project.
(Name of Electrical Subcontractor)

Name_____.

Position_____ Date_____

- i. Failure to provide certification will result in submittals being rejected and returned without review.
- b. Brochures to be submitted as supplementary information shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs that describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.
- c. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Draftsman skilled in this type of work. Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.
- d. Observe the following rules when submitting the Shop Drawings and Brochures.
 - i. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included the submittal will be rejected and returned without being reviewed.
 1. Submittal Identification shall include the following:
 - a. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted.
 - b. Original submittal numbers shall have the following format: "XXX-Y;" where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals (for example, A, B, or C being the first, second, and third resubmittals, respectively). Submittal 25B, for example, is the second resubmittal of Submittal 25.

D. POST-SUBMITTAL

1. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents.

1.3 PROVIDE SUBMITTALS AS REQUESTED FOR EACH OF THE SECTIONS LISTED BELOW:

- A. 26 0519 Conductors and Cables
 1. (600V and Below)
 - a. Submit megohmmeter test data for circuits under 600 volts. Megger all circuits of 100 amp and greater rating.
- B. 26 0526 Grounding
 1. Submit the name of test agency to be used for testing specified in this section. Submit results of tests specified in this section. Also include test results in Operation and Maintenance Manuals as specified.
- C. 26 0536 Raceway Systems
 1. Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of raceway as follows: Surface Metal Raceways.
 2. Submit dimensioned drawings of raceway systems showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, for each type of raceway as follows: Surface metal Raceways
- D. 26 0548 Electrical Seismic Control
 1. A single submittal shall be provided for all seismic anchorage and restraints for all Division 26 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.
 2. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:
 - a. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in Section 26 0548 Specification, and as detailed on drawings.
 - b. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
 - c. Details for all seismic bracing.
 - d. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
 - e. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.
 - f. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
 - g. Include confirmation that all calculations are based on the design criteria listed in appropriate Section.
 - h. Certificate of Compliance.

- i. Where equipment is exempt per this specification provide a written certificate of compliance for each of the systems noted with the professional seal of engineer who has reviewed the electrical system.
- E. 26 0553 Electrical Identification
 - 1. Submit manufacturer's data on each type of electrical identification products
 - a. Submit one sample of each component of the electrical identification system as follows: Wire/cable tape marker, Tags, Engraved, plastic laminate labels, Arc-flash hazard labels
- F. 26 0923 Occupancy Sensors
 - 1. Submit manufacturer's data on occupancy sensors, control modules, wiring diagrams, instructions for installation, interconnection diagrams and any related accessories.
 - 2. Submit scaled drawings with lighting fixtures shown and sensor equipment/devices clearly marked by manufacturer showing proper product, location, coverage pattern and orientation of each sensor.
- G. 26 0943 Lighting Control Equipment
 - 1. Submit manufacturer's data on lighting control equipment including, but not limited to published catalog data sheets, rough-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
 - 2. Submit detailed drawings and documentation of lighting control components and interconnection including, but not necessarily limited to:
 - a. Electronic controllers
 - b. Control stations
 - c. Photo sensors
 - d. Occupancy sensors
 - e. Network wiring details
 - f. Input and output wiring details
 - g. Lighting control panel load schedules
 - h. Accurately scaled equipment layouts, wire/cable routing and connections to control wiring and electrical power feeders.
 - i. Submit scaled drawings/floor plans with locations of all equipment and devices clearly shown for installation purposes.
- H. 26 2726 Wiring Devices
 - 1. Submit manufacturer's data on electrical wiring devices.
- I. 26 2815 Overcurrent Protective Devices
 - 1. Submit manufacturer's data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.
 - 2. Submit layout drawings of overcurrent protective devices, with layouts of circuit

- breakers, including spatial relationships to proximate equipment. Failure to submit said spatial layouts does not relieve contractor of responsibility to verify all required clearances before release of equipment for fabrication.
3. Submit time-current trip curves (in log-log format) and trip setting parameter/range information (for each trip function) for all solid-state circuit breakers.
 4. Manufacturer shall also provide recommended trip settings with the shop drawing submittal (including ground fault settings) for coordination with downstream overcurrent devices. Manufacturer shall base recommendations on the AIC rating of the electrical equipment.
- J. 26 5100 Interior and Exterior Building Lighting
1. Submit manufacturer's data on interior and exterior building lighting fixtures.
 2. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in PDF format with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with each "type" individually bookmarked, with proposed fixture catalog number and accessories clearly indicated on each sheet.
 3. When applicable submit standard color samples with the shop drawings. If standard colors are not acceptable, a color sample will be provided to the fixture manufacturer. Return of the shop drawings will be delayed until color samples are provided.
 4. Submit ballast and/or driver manufacturer cut sheets.
 5. Submit a list of all lamps used on projects.
- K. 27 1500 Telephone Data Systems
1. Provide proof of RCDD certification and connectivity manufacturer certification.
 2. Provide submittals for all racks/cabinets; patch panels, devices, cabling, firestopping solutions, tray, non-continuous cable support devices, grounding equipment, and miscellaneous equipment to be used on project. Where multiple part numbers are listed on a datasheet/cutsheet, highlight or circle applicable part.
 3. Provide submittals showing complete racking layout in plan and elevation view to scale. Coordinate exact rack layout with Owner Information Technology Representative prior to submittal.
 4. Provide color samples of all available standard color faceplates to architect.
 5. Provide proposed labeling scheme for approval by owner/engineer.
 6. Provide catalog cutsheets of all test equipment that will be used.
- L. 28 3111 Voice Evacuation Fire Alarm and Detection System
1. Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
 2. Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic. Shop drawings shall be prepared by an individual with a

- minimum NICET III (Fire Protection Engineering Technology/Fire Alarm Systems) certification. The individual's name and certification number shall be shown on the submittal design drawings.
3. Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.
 4. A complete set of shop drawings indicating:
 - a. Location of all alarm-initiating and alarm-signaling devices.
 - b. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.
 - c. Standby battery calculations, including voltage drop calculation.
 5. Wiring diagrams for:
 - a. Alarm control panels.
 - b. Auxiliary function relays and solenoids.
 - c. Remote signaling equipment.
 6. A complete equipment list identifying:
 - a. Type
 - b. Model
 - c. Manufacturer
 - d. Manufacturer catalog data sheets
 - e. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)
 7. A complete zone list identifying all:
 - a. Alarm-initiating and alarm-signaling devices.
 - b. Remote signaling and auxiliary function zones.
 - c. Specific devices associated with each zone.
 8. Submit to State and Local Fire Marshall, a complete Certificate of Compliance

1.4 RECORD DRAWINGS / OPERATION & MAINTENANCE MANUALS

- A. Provide operating instruction and maintenance data books for all equipment and materials furnished under this Division.
 - B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item. The binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones WLJ36544B). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.
 - C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of
-

replacement parts, motor ratings, etc. Each unit shall have its own individual sheet. (Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified).

- D. Include the following information where applicable.
1. Identifying name and mark number.
 2. Certified outline Drawings and Shop Drawings.
 3. Parts lists.
 4. Performance curves and data.
 5. Wiring diagrams.
 6. Light fixture schedule with the lamps and ballast data used on the project for all fixtures
 7. Manufacturer's recommended operating and maintenance instructions.
 8. Vendor's name and address for each item.
- E. The engineer shall review the manuals and when approved, will forward the manuals on to the architect. If the manuals are rejected twice, the contractor shall reimburse the engineer the sum of \$1,200.00 for each review afterwards.
- F. Show all changes, deviations, addendum items, change orders, job instructions, etc., that change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.
- G. Provide Operation and Maintenance Manual information for each section listed below in addition to the general requirements listed above.
1. 26 0526 Grounding
 - a. Test Results of measured resistance values
 2. 26 0548 Electrical Seismic Control
 - a. Certificate of Compliance from Final Inspection
 3. 26 0923 Occupancy Sensors
 - a. Record Drawings
 - i. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
 - ii. Provide a CD to the owner containing the information specified below. The CD shall include all information required to allow the Owner to change the schedules themselves. The CD shall contain a minimum of following:
 1. CAD drawing files of 'as-built' lighting control components and point to point connections.

2. General configuration programming.
 3. Job specific configuration programming to include schedule.
 4. Tutorial file on complete programming of lighting control system.
4. 26 0943 Lighting Control Equipment
 - a. Record Drawings
 - i. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
 - ii. Provide a CD to the owner containing the information specified below. The CD shall include all information required to allow the Owner to change the schedules themselves. The CD shall contain a minimum of following:
 1. CAD drawing files of 'as-built' lighting control components and point to point connections.
 2. General configuration programming.
 3. Job specific configuration programming to include schedule.
 4. Tutorial file on complete programming of lighting control system.
5. 27 1500 Telephone/Data System
 - a. Test Results as outlined in Section 27 1500
 - b. Manual shall include all service, installation, programming and warranty, including test results for each cable.
 - c. Provide laminated plans (minimum size 11 x 17) of all telecommunications record drawings (including riser diagrams) in each and every EF, ER and TR.
 - d. Record Drawings
 - i. The Owner shall provide electronic (DWG) format of telephone/data system drawings that as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
 - ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment within 30 working days of completion. Drawings are to

include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

6. 28 3113 Fire Alarm and Detection System
 - a. Manual Requirements
 - i. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.
 - b. Record Drawings
 - i. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.
 - ii. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).
 - iii. Provide a CD to the Owner containing the information specified below. The CD shall include all information required to allow the Owner to change the fire alarm program themselves. The CD shall contain a minimum of the following:
 1. CAD drawing files of building fire alarm map.
 2. CAD drawing files of as-built fire alarm components and point to point connections.
 3. General configuration programming.
 4. Job specific configuration programming.
 5. Tutorial file on complete programming of fire alarm system

1.5 SPARE PARTS:

- A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Stock of all spare items shall be delivered as directed to Owner's storage space prior to substantial completion. All

components shall be labeled to match construction document nomenclature.

Section	Section Name	Description	Qty. Required	Qty. Received	Fulfilled ?
26 0923	Occupancy Sensors	Spare sensors for each type used on project.	5 per type		
26 5100	Interior and Exterior Building Lighting	Provide a complete spare parts list in lighting shop drawing review			

END OF SECTION 26 0502

BLANK PAGE

**SECTION 260507 - ELECTRICAL CONNECTIONS FOR EQUIPMENT
PART 1 - GENERAL**

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-23 section making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical connection for equipment includes final electrical connection of all equipment having electrical requirements. Make final connections for all owner furnished equipment. See other applicable portions of specification for building temperature control wiring requirements.
- B. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment; not work of this section.
- C. Refer to Division-23 section for control system wiring; not work of this section.
- D. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE:

- A. NEC COMPLIANCE: Comply with applicable portions of NEC as to type products used and installation of electrical power connections.
- B. UL LABELS: Provide electrical connection products and materials that have been UL-listed and labeled.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. Crimp on or slip-on type splicing materials (insulation displacement type) designed to be used without wire stripping are not acceptable. See Section 26 0532, Conduit Raceways; Section 26 2726 Wiring Devices; and Section 26 0519 Conductors and Cables for additional requirements. Provide final connections for equipment consistent with the following:
 - 1. Permanently installed fixed equipment - flexible seal-tite conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.
 - 2. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).

3. Other methods as required by the National Electrical Code and/or as required by special equipment or field conditions.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS:

- A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.
- C. Coordinate installation of electrical connections for equipment with equipment installation work.
- D. Verify all electrical loads (voltage, phase, horse power, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, **by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics.** Report any variances from electrical characteristics noted on the electrical drawings to Architect **before proceeding** with rough-work. In summary it is not in the Electrical Engineers scope to review the shop drawings from other trades/divisions.
- E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.
- F. Refer to basic materials and methods Section 26 0553 Electrical Identification, Conductors, for identification of electrical power supply conductor terminations.

END OF SECTION 26 0507

SECTION 26 0519 - CONDUCTORS AND CABLES (600V AND BELOW)
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to conductors and cables specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.
- B. Types of conductors and cables in this section include the following:
 - 1. Copper Conductors (600V)
- C. Applications for conductors and cables required for project include:
 - 1. Branch Circuits

1.3 RECORDS SUBMITTAL: Refer to Section 26 0502 for requirements.

1.4 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables that have been UL-listed and labeled.
- B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.
- C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

1.5 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 COPPER CONDUCTORS (600V):

- A. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated for each service. Where not indicated provide proper selection to comply with project's installation requirements and NEC standards. Provide conductors in accordance with the following:
 - 1. Branch Circuit Conductors and All Conductors #3 AWG and Smaller - Copper conductor, with THHN/THWN insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG. Provide solid conductors for #10 AWG and smaller. Provide stranded conductors for #8 AWG and larger.
- B. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a

means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.

- C. Provide neutral and ground wire as specified elsewhere in documents.
- D. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation", and in accordance with recognized industry practices.
- B. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- C. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved swivel connection. Nonmetallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop that pull wires can be attached; remove insulation from conductors before forming the loop. Larger sizes of cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.
- D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.
- E. Pull in cable from the end having the sharpest bend; i.e. bend shall be closest to reel. Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.
- F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.
- G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.
- H. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and that is listed by UL.
- I. Seal all cable ends unless splicing is to be done immediately. Conduit bodies shall not contain splices.
- J. Follow manufacturer's instructions for splicing and cable terminations.

3.2 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW:

- A. Prior to energization, test cable and wire for continuity of circuitry, and for short circuits,

Megger all circuits of 100 amp and greater rating. Correct malfunctions. Record all test data and provide written test report.

- B. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements.

3.3 IDENTIFICATION OF FEEDERS: Refer to Section 26 0553 for requirements.

END OF SECTION 26 0519

BLANK PAGE

SECTION 26 0526 - GROUNDING
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

- A. Provide grounding as specified herein, and as indicated on drawings.
- B. Provide grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, and items required by the NEC to provide a permanent, continuous, low impedance, grounding system.
- C. Unless otherwise indicated, ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, and equipment in accordance with all code requirements.
- D. Ground each separately derived system, as described in NEC Section 250-30, unless otherwise indicated.
- E. Types of grounding in this section include the following:
 - 1. Grounding Electrodes
 - 2. Separately Derived Systems
 - 3. Enclosures
 - 4. Systems
 - 5. Equipment
 - 6. Other items indicated on drawings
- F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

1.3 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products that have been UL listed and labeled.
- B. Resistance from the service entrance ground bus, through the grounding electrode to earth, shall not exceed 5 ohms.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS:

- A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as

specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

- B. ELECTRICAL GROUNDING CONDUCTORS: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. Provide with green insulation.
- C. INSULATED GROUNDING BUSHINGS: Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners, OZ-Gedney BLG, or Thomas & Betts #TIGB series.
- D. CONNECTIONS TO PIPE: For cable to pipe, OZ-Gedney G-100B series or Thomas & Betts #390X series, or Burndy type GAR.
- E. BONDING JUMPERS: OZ-Gedney Type BJ, or Thomas & Betts #3840 series, or Burndy type GG and type B braid.

PART 3 - EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS:

- A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.
- B. Install clamp-on connectors only on thoroughly cleaned and metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- C. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All raceways shall include copper grounding conductor sized in accordance with NEC.

3.2 GROUNDING ELECTRODES:

- A. Separately Derived Electrical System Grounding Electrode: Ground each separately derived system per requirements in NEC Section 250-26 unless indicated otherwise.
- B. GROUNDING ELECTRODE CONDUCTOR: Provide grounding electrode conductor sized per NEC table 250-94 or as indicated.
- C. Run main grounding conductors exposed or in metallic conduit if protection or concealment is required.
- D. EQUIPMENT BONDING/GROUNDING: Provide a NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:
 - 1. Motor and equipment branch circuits.
 - 2. Device and lighting branch circuits.
 - 3. Provide grounding bushings and bonding jumpers for all conduit terminating in reducing washers, concentric, eccentric or oversized knockouts at panelboards, cabinets and gutters.
- E. Provide bonding jumpers across expansion and deflection couplings in conduit runs,

across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system.

- F. Provide bonding wire in all flexible conduit.

3.3 TESTING:

- A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section.
- B. Include typewritten records of measured resistance values in the Operation and Maintenance Manual.
- C. Use independent testing agency for all testing.
- D. Use test equipment expressly designed for the purpose intended. Submit name of testing agency for review and approval, in writing, to the Engineer prior to the performance of any testing.

END OF SECTION 26 0526

BLANK PAGE

SECTION 26 0529 - SUPPORTING DEVICES
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification section, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to supports, anchors, sleeves, and seals, specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of supports, anchors, and sleeves is indicated by drawings and schedules and/or specified in other Division-26 sections. See Section 260532, Raceways, for additional requirements.
- B. Work of this section includes supports, anchors, sleeves and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hole conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, threaded rods and all associated accessories.

1.3 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies". Provide electrical components that are UL-listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES:

- A. GENERAL:
 - 1. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawings for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES:

- A. Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.
- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

- C. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. For pre-and post tensioned construction, use pre-set inserts for support of all electrical work. Do not use toggle bolts, moly bolts, wood plugs or screws in sheetrock or plaster as support for any equipment or raceway.
- D. RACEWAYS:

1. Support raceways that are rigidly attached to structure at intervals not to exceed 8 feet on center, minimum of two straps per 10 foot length of raceway, and within 12" of each junction box, coupling, outlet or fitting. Support raceway at each 90° degree bend. Support raceway (as it is installed) in accordance with the following:

<u>NUMBER OF RUNS</u>	<u>3/4" TO 1-1/4" Ø</u>	<u>1-1/2" & LARGER Ø</u>
1	Full straps, clamps or hangers.	Hanger
2	Full straps, clamps or hangers.	Mounting Channel
3 or more	Mounting Channel	Mounting Channel

2. Support suspended raceways on trapeze hanger systems; or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use independent support wires as a portion of any raceway support system; do not support raceway from ceiling support wires.

END OF SECTION 26 0529

SECTION 26 0532 - CONDUIT RACEWAY
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways and specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the following:
 - 1. Electrical Metallic Tubing
 - 2. Flexible Metal Conduit
 - 3. Intermediate Metal Conduit
 - 4. Liquid-tight Flexible Metal Conduit

1.3 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 three (3) years.
- B. **STANDARDS:** Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.
- C. **SUBMITTALS:** Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 METAL CONDUIT AND TUBING:

- A. **GENERAL:**
 - 1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".
- B. **ALUMINUM CONDUIT:** Not acceptable.
- C. **MC CABLE:** Not acceptable.
- D. **ELECTRICAL METALLIC TUBING (EMT):** FS WW-C-563 and ANSI C80.3.
- E. **EMT FITTINGS:**
 - 1. Provide insulated throat nylon bushings with non-indenter type malleable steel fittings at all conduit terminations. Install OZ Type B bushings on conduits 1" larger. Cast or indenter type fittings are not acceptable.

- F. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type;
 - 1. Zinc-coated steel.
- G. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 1, and Style A.
- H. LIQUID TIGHT FLEXIBLE METAL CONDUIT:
 - 1. Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).
- I. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3, Style G.
- J. EXPANSION FITTINGS: OZ Type AX, or equivalent to suit application.

2.2 CONDUIT; TUBING; AND DUCT ACCESSORIES:

- A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, that mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.3 SEALING BUSHINGS:

- A. Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

2.4 CABLE SUPPORTS:

- A. Provide OZ cable supports for vertical risers, type as required by application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

- A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with the following:
 - 1. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS:
 - a. Install in electric metallic tubing (EMT).
- B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
- C. Install raceway in accordance with the following:
 - 1. Provide a minimum of 12" clearance measured from outside of insulation from flues, steam and hot water piping, etc. Avoid installing raceways in immediate vicinity of boilers and similar heat emitting equipment. Conceal raceways in finished walls, ceilings and floor (other than slab-on-grade), except in mechanical, electrical and/or communication rooms, conceal all conduit and connections to motors, equipment, and surface mounted cabinets unless exposed work is indicated on the drawings. Run concealed conduits in as direct a line as possible with gradual bends. Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines. Do not install

- lighting raceway until piping and duct work locations have been determined in order to avoid fixtures being obstructed by overhead equipment.
2. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway. Paint all field threads (or portions of raceway where corrosion protection has been damaged) with primer and enamel finish coat to match adjacent raceway surface.
 3. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
 4. Provide neutral and ground wire as specified elsewhere in documents.
 5. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.
- D. Comply with NEC for requirements for installation of pull boxes in long runs.
- E. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandrel and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.
- F. Replace all crushed, wrinkled or deformed raceway before installing conductors.
- G. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.
- H. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.
- I. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.
- J. Electrical Identification: Refer to Section 260553 for requirements.
- K. SPARE PARTS: Refer to Section 26 0502 for requirements.

END OF SECTION 26 0532

BLANK PAGE

SECTION 26 0533 - ELECTRICAL BOXES AND FITTINGS
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to electrical wiring boxes and fittings specified herein. See Section 260532, Raceways, for additional requirements.

1.2 DESCRIPTION OF WORK:

- A. The extent of electrical box and electrical fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
 - 1. Outlet Boxes
 - 2. Junction Boxes
 - 3. Pull Boxes
 - 4. Conduit Bodies
 - 5. Bushings
 - 6. Locknuts
 - 7. Knockout Closures
 - 8. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134,1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings that have been UL-listed and labeled.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

- A. INTERIOR OUTLET BOXES:
 - 1. Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes with accessory rings, of types, shapes and sizes, including box depths, to suit each respective location and installation, construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices; minimum size 4"x4"x2-1/8".
 - 2. Provide an 'FS' box, with no knockouts when surface mounted in a finished, non-utility space. Surface mounting is only acceptable when approved by the Architect.

- B. INTERIOR OUTLET BOX ACCESSORIES:
 - 1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, that are compatible with outlet boxes being used and fulfilling requirements of individual wiring applications.
- C. JUNCTION AND PULL BOXES:
 - 1. Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- D. CONDUIT BODIES:
 - 1. Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.
- E. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS:
 - 1. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable steel conduit bushings and offset connectors, of types and sizes to suit respective uses and installation.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

- A. GENERAL:
 - 1. Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
 - 2. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
 - 3. Provide coverplates for all boxes. See Section 262726, Wiring Devices.
 - 4. Provide knockout closures to cap unused knockout holes where blanks have been removed.
 - 5. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Do not install boxes above ducts or behind equipment. Install recessed boxes with face of box or ring flush with adjacent surface. Seal between switch, receptacle and other outlet box openings and adjacent surfaces with plaster, grout, or similar suitable material.
 - 6. Fasten boxes rigidly to substrates or structural surfaces, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them. Set boxes on opposite sides of fire resistant walls with minimum of 24" separation.
 - 7. Provide electrical connections for installed boxes.

END OF SECTION 26 0533

SECTION 26 0536 - RACEWAY SYSTEMS
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 Section making reference to electrical raceways specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the following:
 - 1. Surface metal raceways

1.3 QUALITY ASSURANCE:

- A. STANDARDS:
 - 1. Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURED RACEWAY SYSTEMS:

- A. GENERAL:
 - 1. Provide electrical raceways of types, grades, sizes, weights [wall thicknesses], and number of channels, for each service indicated. Provide complete assembly of raceway including, but not necessarily limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as needed for complete system.
- B. SURFACE METAL RACEWAYS:
 - 1. Provide surface metal raceways of sizes and channels indicated. Provide fittings indicated that match and mate with raceway. Paint with manufacturer's standard prime coating and finish color as indicated. Provide receptacles on centers as indicated on drawings or as directed by engineer.
 - 2. MANUFACTURER:
 - a. Subject to compliance with requirements, provide surface metal raceways of one of the following:
 - i. Wiremold Company

- ii. Hubbell Incorporated

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

- A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.
- B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
- C. Level and square raceway runs, and install at proper elevations/heights.

3.2 ADJUSTING AND CLEANING:

- A. Upon completion of installation of raceways, inspect interiors of raceways; remove burrs, dirt and construction debris.

END OF SECTION 26 0536

SECTION 26 0548 - ELECTRICAL SEISMIC CONTROL
PART 1 – GENERAL

1.1 WORK INCLUDED:

- A. Anchorage and seismic restraint systems for all Division 26 isolated and non-isolated equipment, cable tray, and conduit systems.
- B. Anchorage and seismic restrain systems for electrical components shall include but not be limited to the following:
 - 1. Conduit
 - 2. Light Fixtures

1.2 RELATED WORK:

- A. Requirements: Provide Electrical Seismic Control in accordance with the Contract Documents.
- B. Section 260500 – Electrical General Provisions

1.3 REFERENCES:

- A. International Building Code, Current Edition in use by Jurisdictional Authority.
- B. NFPA Bulletin 90A, Current Edition.
- C. UL Standard 181.
- D. ASCE 7-10

1.4 SYSTEM DESCRIPTION

- A. The Division 26 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:
 - 1. Short period design spectral response acceleration coefficient $SDS=0.70$.
 - 2. One second period design spectral response acceleration coefficient $SD1=0.28$.
 - 3. Site Class B.
 - 4. Seismic Design Category D.
 - 5. Importance Factor (I_p) = 1.0
- B. Seismic Restraint Exceptions
 - 1. The following components are exempt from the requirements of this section

1.5 QUALITY ASSURANCE:

- A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for electrical equipment. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division

- 26 equipment and systems shall be provided by a single firm.
- B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the electrical equipment that have been submitted, reviewed and accepted by the Architect/Engineer for this project.
 - C. Seismic Engineer or the Engineer's Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer's design. A certificate of compliance bearing the Seismic Engineer's signed Professional Engineer's seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.
 - D. The Division 26 Contractor shall require all equipment suppliers furnish equipment that meets the seismic code, with bases/skids/curb designed to receive seismic bracing and/or anchorage. All isolated and non-isolated electrical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in Paragraph 1.4 above, with direct anchorage capability.

1.6 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS:

2.1 RESTRAINT EQUIPMENT AND SYSTEMS:

- A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:
 - 1. Mason Industries, Inc.
 - 2. Korfund
 - 3. Amber/Booth Company
 - 4. Vibration Mountings and Control Company
 - 5. Kinetics
 - 6. International Seismic Application Technology
 - 7. Tolco
- B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment.

2.2 SNUBBERS:

- A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.
- B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.
- C. Snubbers shall be Mason Industries Z -1011 or accepted equivalent.

PART 3 – EXECUTION

3.1 DESIGN AND INSTALLATION:

- A. General:

1. All electrical components shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials, and equipment for protection against seismic disturbances as specified herein. The following electrical components are exempt from seismic restraint requirements.
 - a. Electrical components in Seismic Design Category A or B (see section 1.4)
 - b. Electrical components in Seismic Design Category C provided that the component importance factor, I_p , is equal to 1.0 (see section 1.4).
 - c. Electrical components in Seismic Design Categories D, E, or F where all of the following apply:
 - i. The component importance factor, I_p , is equal to 1.0;
 - ii. The component is positively attached to the structure;
 - iii. Flexible connections are provided between the component and associated ductwork, piping, and conduit; and either
 1. The component weighs 400 lb (1,780 N) or less and has a center of mass located 4 ft (1.22 m) or less above the adjacent floor level; or
 2. The component weighs 20 lb (89 N) or less or, in the case of a distributed system, 5 lb/ft (73 N/m) or less.
2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.
3. Attachments and supports for electrical equipment shall meet the following provisions:
 - a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).
 - b. Friction clips shall not be used for anchorage attachment.
 - c. Expansion anchors shall not be used for electrical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.
 - d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.
 - e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.

- f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as $2F_p$. The intent is to prevent excessive movement and to avoid fracture of support springs and any non-ductile components of the isolators.
 - g. Seismic supports shall be constructed so that support engagement is maintained.
- B. Conduit, Conduit Racks/Trapeze Assemblies, Cable Tray and Bus Duct:
- 1. Seismic braces for be omitted when the distance from the supporting structure to the raceway support point is 12" or less. Where rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod.
 - 2. Seismic braces may be omitted where the total weight of the assembly is less than 10 lb/ft.
 - 3. Seismic braces for individual conduit may be omitted for conduit less than 2.5 inch trade size.
 - 4. A rigid conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
 - 5. Unbraced conduit attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
 - 6. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
 - 7. Provide large enough pipe sleeves through wall or floors to allow for anticipated differential movements.
 - 8. For spaces, where the Importance Factor (I_p) is equal to 1.5, all electrical components that are attached to structures that could displace relative to one another and for isolated structures where components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacements.
- C. Light Fixtures
- 1. Light fixtures, lighted signs, and ceiling fans not connected to ducts or piping, which are supported by chains or otherwise suspended from the structure, are not required to satisfy the seismic force and relative displacement requirements provided they meet all of the following criteria:
 - a. The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be applied in the direction that results in the most critical loading for the design.
 - b. Seismic interaction effects shall not cause an effect so that the failure of the non-essential component causes a failure of an essential component.
 - c. The connection to the structure shall allow a 360° range of motion in the horizontal plane.

- d. The component is less than 20 lbs and has flexible connections and an importance factor (I_p) equal to 0.

END OF SECTION 26 0548

BLANK PAGE

SECTION 26 0553 - ELECTRICAL IDENTIFICATION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements".
 - 2. "Basic Electrical Materials and Methods".

1.2 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 labels for raceways, cables and conductors.
 - 2. Operational instruction signs.
 - 3. Warning and caution signs.
 - 4. Equipment labels and signs.
- B. Related Sections: The following sections contain requirements that relate to this section:
- C. Division 9 Section "Painting" for related identification requirements.
- D. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.3 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code"

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. American Labelmark Co.
 - 2. Calpico, Inc.
 - 3. Cole-Flex Corp.
 - 4. Emed Co., Inc.
 - 5. George-Ingraham Corp.
 - 6. Ideal Industries, Inc.

7. Kraftbilt
8. LEM Products, Inc.
9. Markal Corp
10. National Band and Tag Co.
11. Panduit Corp.
12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W.H Brady, Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Colored Conduit Systems for raceway identification:
 1. Factory-painted conduit and/or factory-painted couplings and fittings
- B. Colored paint for raceway identification:
 1. Use [Kwal Paint](#) colors as specified in Part 3 – Execution.
- C. Color Adhesive Marking Tape for Raceways, Wires and Cables:
 1. Self-adhesive vinyl tape not less than 3 mills thick by 1" to 2" in width.
- D. Wire/Cable Designation Tape Markers:
 1. Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letters.
- E. Brass or Aluminum Tags:
 1. Metal tags with stamped legend, punched for fastener.
 2. Dimensions: 2" X 2" 19 gage.
- F. Engraved, Plastic Laminated Labels, Signs and Instruction Plates:
 1. Engraving stock plastic laminate, 1/16" minimum thickness for signs up to 20 sq. in. or 8" in length; 1/8 " thick for larger sizes. Engraved legend in 1/4" high white letters on black face and punched for mechanical fasteners.
- G. Equipment Labels:
 1. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
 2. Dimensions: minimum 5" x 2"
 3. Conductor-Identification-Means Labels:
 - a. Information contained: the method utilized for identifying ungrounded conductors within switchboards, distribution panels and branch circuit panels.
 4. Source-of-Supply Labels:
 - a. Information contained: indicate the device or equipment where the power supply originates.
- H. Baked Enamel Warning and Caution Signs for Interior Use:

1. Preprinted aluminum signs, punched for fasteners, with colors legend and size appropriate to location.
- I. Fasteners for Plastic-Laminated and Metal Signs:
 1. Self-tapping stainless steel screws or # 10/32 stainless steel machine screws with nuts, flat and lock washers.
- J. Cable Ties:
 1. Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18" minimum width, 50-lb. Minimum tensile strength, and suitable for a temperature range from minus 40° F. to 185° F. Provide ties for specified colors when used for color coding.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics:
 1. 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.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work:
 1. Where identification is to be applied to surfaces that require a finish, install identification after completion of finish work.
- D. Conduit Identification:
 1. Identify Raceways of Certain Systems with Color Coding. Acceptable means of color identification are as follows:
 - a. Colored adhesive marking tape.
 - b. Field-painted colored bands.
 - c. Color exposed or accessible raceways of the following systems for identification. Make each color band 2 inches wide, completely encircling conduit. Apply bands at changes in direction, at penetrations of walls and floors, and at 20-foot maximum intervals in straight runs. Apply the following colors:
 - i. Fire Alarm System: Red
 - ii. Sound/IC: Blue
 - iii. Telephone: Yellow
 - iv. Data: Green
 - v. MATV: Black
 - vi. Security: Orange
 2. Identify Junction, Pull and Connection Boxes.
 - a. Code-required caution sign for boxes shall be pressured-sensitive, self-adhesive label indication system voltage in black, preprinted on orange

background. Install on outside of box cover. Also label box covers on outside of cover with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

3. Label and paint the covers of the systems junction boxes as follows:

<u>SYSTEM</u>	<u>COLOR (ALL COLORS ARE KWAL PAINT)</u>	
Fire Alarm	Red Alert	AC118R
Sound/IC	Neon Blue	7076A
Telephone	Competition Yellow	7225A
Data	Java Green	AC098N
MATV	Flat Black	
Security	Fiesta Orange	AC107Y

- E. Conductor Color Coding.

1. Provide color coding for secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

<u>CONDUCTOR</u>	<u>208Y / 120V System</u>	<u>480Y / 277V System</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Shared/Single Neutral	White	Gray
Neutral A (dedicated)	White w/Black Stripe	Gray w/Black Stripe
Neutral B (dedicated)	White w/Red Stripe	Gray w/Orange Stipe
Neutral C (dedicated)	White w/Blue Stripe	Gray w/Yellow Stipe
Equipment Ground	Green	Green
Isolated Ground	Green w/Yellow Strip	Green w/Yellow Stripe

2. Switch legs, travelers and other wiring for branch circuits shall be of colors other than those listed above.
3. Use conductors with color factory applied the entire length of the conductors except as follows:
 - a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - b. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

- d. Metal-enclosed switchgear, unit substations, transformers, enclosures, pull boxes, connection boxes and similar equipment operating at over 600 volts shall have appropriate caution signs and warning labels.
 - e. Indoor and Outdoor substations operating over 600 volts. Provide warning signs, instructional signs and single-line diagrams in accordance with NEC 225.70.
- H. Emergency Operating Signs: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- I. 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. Except as otherwise indicated, provide single line of text, with 1/4"-high lettering on 1-inch-high label (1 1/2-inch-high where two lines are required) white lettering in black field. White lettering in red field for Emergency Power Systems. 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. Each service disconnect, to identify it as a service disconnect.
 - b. Panelboards (exterior and interior), electrical cabinets, and enclosures. For subpanels, identify feeder circuit served from.
 - c. Switches in fusible panelboards shall be labeled. Main switches shall be identified.
 - d. Access doors and panels for concealed electrical items.
 - e. Electrical switchgear and switchboards.
 - f. Motor control centers.
 - g. Motor starters, including circuit origination, HP, heater size, FLA, and mechanical equipment designation.
 - h. Disconnect switches.
 - i. Pushbutton stations.
 - j. Power transfer equipment.
 - k. Contactors.
 - l. Dimmers.
 - m. Control devices.
 - n. Transformers.
 - o. Power generating units, to include transfer switches.
 - p. Telephone switching equipment.
 - q. Clock/program master equipment.
 - r. Call system master station.
 - s. TV/audio monitoring master station.
 - t. Fire alarm master station or control panel.

- u. Busduct – Label all cable tap boxes, bus plug-in units, etc. with plastic laminate labels designating load served.
 - v. Variable frequency drives.
 - w. Lighting Control Equipment.
 - x. Uninterruptable Power Supply.
- J. Post Conductor-Identification-Means labels at locations of switchboards, distribution panels and branch circuit panels. The labels shall identify the color-coding used on ungrounded conductors for each voltage system used on the premises.
- K. The label shall identify the device or equipment where the power supply originates, and the system voltage and phase. For example: Feeder Power Supply for Panel “XX” Originates at Panel “XX” (or Switchboard “XX”, Transformer “XX”, Switch “XX”, etc.); 120/208 volts, 3-phase (or 120/240, 277/480, etc.).
- L. 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.
- M. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- N. Engrave all receptacle plates other than those serving 120 volt, single phase devices. State voltage and amperage characteristics: Example; “208V 30A”.
- O. Mark each device box (for each type of wiring device) with a permanent ink felt tip marker, indicating the circuit that the device is connected to: Example; “CKT A-1”
- P. Label circuit breaker feeding fire alarm panel “Fire Alarm Circuit”. Using plastic laminate label, white lettering on a red background.

END OF SECTION 26 0553

BLANK PAGE

SECTION 26 0923 - OCCUPANCY SENSORS
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

- A. The extent of occupancy sensor work is indicated by drawings and schedules.
- B. Types of occupancy sensors in this section include the following:
 - 1. Control Pack
 - 2. Dual Technology Wall Switch
 - 3. Dual Technology Wall Switch with Dimming and Daylight Control.
 - 4. Dual Technology Ceiling Sensor w/ Control Pack

1.3 QUALITY ASSURANCE:

- A. Comply with NEC and NEMA standards as applicable to construction and installation of occupancy sensors. Provide occupancy sensors that have been UL listed and labeled.
- B. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, motor loads and any other passive infrared or microwave systems.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURER: The manufacturer shall have a minimum of five years of experience in the sensor and lighting control industry. Sensors and related relays shall be compatible with the specific lighting types controlled. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable.

- A. **DUAL TECHNOLOGY WALL SWITCH:** Where units are indicated provide a sensor that meets the following minimum requirements:
 - 1. Sensor shall utilize PIR (Passive Infrared) to turn on the lights and then PIR or US (Ultrasonic) technologies to keep lights on.
 - 2. Sensor shall incorporate an inrush current limiter circuit to protect the relay contacts.
 - 3. Sensor shall utilize single or dual dry relay contacts for control of the lighting loads. Contractor shall verify requirements in coordination with the drawings.
 - 4. Sensor shall have a self-adjusting time delay, selectable 5, 15 and 30 minutes.
 - 5. Sensor shall have automatic sensitivity adjustment and be microprocessor controlled.

6. Sensor shall have light level sensing 0 to 200 footcandles.
 7. Sensor shall have a 180 degree field of view, coverage up to 800 square feet and shall detect 6 inches of hand movement towards the sensor up to 300 square feet; and body motion towards the sensor up to 1000 square feet.
 8. Sensor shall be rated for 0 to 800 watts at 120VAC and 0 to 1200 watts at 277VAC.
 9. Sensor shall be automatic on and shall have an automatic to off override switch on the unit. Switch shall be equipped with an air gap switch to disconnect power to the lighting load.
 10. Sensor shall have real time motion indicator on the front of the unit.
 11. Sensor shall mount to a single gang switch box.
 12. Subject to compliance with the above requirements. Provide models of one of the following:
 - a. Greengate ONW-DT
 - b. Sensor Switch WSX PDT Series
 - c. Douglas WOS Series
- B. DUAL TECHNOLOGY WALL SWITCH WITH DIMMING AND DAY-LIGHT CONTROL:
Where units are indicated, provide a sensor that meets the following minimum requirements:
1. Dual technology sensors shall have one of its two technologies, not require motion to detect occupancy.
 2. Sensors shall offer a minimum on timer of at least 15 minutes, in order to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period.
 3. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 15 minutes.
 4. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated.
 5. Sensor shall be capable of switching both 120 VAC and 277 VAC.
 6. Sensor shall recess into single gang switch box and fit standard GFI opening.
 7. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
 8. Line and load wire connections shall be interchangeable.
 9. Wall switch sensor shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point.

10. Sensor shall be capable of both auto-on and manual operation.
 11. Combination photocell/dimming sensors set point and deadband shall be automatically calibrated through the sensors microprocessor by initiating the automatic set point programming procedure. Min and max dim settings as well as set point may be manually entered.
 12. Subject to compliance with the above requirements, provide models of one of the following:
 - a. Sensor-Switch – WSX-PDT-D Series
 - b. Green Gate – CSW-d-010
- C. DUAL TECHNOLOGY CEILING SENSOR: Where units are indicated, provide a sensor that meets the following minimum requirements:
1. Sensor shall incorporate ultrasonic (microphonics) and infrared technologies in a single unit.
 2. Sensor shall be Class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
 3. Sensor shall use internal microprocessor for motion signal analysis and automatic self-adjustment.
 4. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
 5. Sensor shall have manual time-out adjustment from 8 minutes to 32 minutes and automatic time out from 8 minutes to 100 minutes.
 6. Sensor shall have test time-out setting of 8 seconds, with automatic return to 8 minutes after one hour if sensor is left in test mode.
 7. Sensor's microprocessor shall automatically extend timer by 1 hour in response to recognition to false off condition. After 5 hours, sensor reduces extended time by 30 minutes and continues to reduce by 30 minute increments over the next few days.
 8. Sensor's microprocessor shall automatically reduce either PIR or ultrasonic sensitivity in response to false on condition.
 9. Sensor microprocessor will automatically monitor PIR background threshold signal level and makes corresponding sensitivity adjustments automatically.
 10. Sensor microprocessor algorithm shall incorporate automatic adaptation to continuous airflow.
 11. For airflow that is so intense as to mask motion, sensor shall flash indicator LED code to indicate excessive airflow.
 12. Sensor's microprocessor shall use a four week learning period and develop a circadian calendar.
 13. An internal 24 hour 7 day clock establishes what periods the room is typically occupied, biasing sensor to keep lights on while normally occupied and off when normally unoccupied.
 14. Sensor shall have selection settings for the following dual technology schemes:

- a. High Sensitivity and High Confidence (miser mode)
 15. Sensor shall be available with either 180 degrees or 360 degrees coverage pattern.
 16. Infrared lens shall have 360 degree field of view. Two types of lens shall be available, standard and extra dense.
 17. Sensor shall have a variety of mask inserts for PIR coverage rejection to prevent false tripping.
 18. Transducers shall be protected from tampering.
 19. Sensor shall have manual adjustments for timer and sensitivities and override switches to force manual adjustment mode.
 20. Sensor shall have adjustable sensitivity from 0% to 100% for both ultrasonic and infrared.
 21. Controls shall be behind cover to resist tampering. All adjustments shall be accessible from the front of the sensor.
 22. Sensor shall be available with a photocell adjustment from 20 to 3,000 Lux.
 23. Sensor shall provide internal operating status and settings confirmation via LED motion lamp indicator.
 24. Sensor shall have two (if 180 degree) or three (if 360 degree) real time LED motion indicators visible from the front of the unit: Red = infrared; green = ultrasonic.
 25. Subject to compliance with the above requirements, provide models of one of the following:
 - a. Hubbell-ATD Series
 - b. Sensor Switch-CM-PDT 9/10 Series
 - c. Wattstopper-DT Series
 - d. Mytech-Omni-DT Series
 - e. Leviton – OSC UOW Series
 - f. Greengate OAC– DT Series
 - g. Douglas – WOR Series
- D. 24 VDC POWER/CONTROL PACK: Where units are indicated, provide a power/control pack that meets the following minimum requirements:
1. Control module shall consist of a DC power supply and a dry contact relay for switching a lighting load.
 2. Control module shall be available in versions to accept 120, and 277 VAC line voltages.
 3. Output shall be 24VDC nominal, and shall be inherently safe, low voltage, limited power output (Class 2).
 4. Output shall supply 100mA current, in addition to current consumed internally to operate internal relay.
 5. Relay shall utilize normally open, silver alloy dry contacts, and shall be rated for a 20A ballast load at 120V and 277V.
 6. Relay function shall not require more than 5 mA control current to operate.

7. Control module shall have line voltage wiring, consisting of input voltage and relay contact connections, exiting from one end, and low voltage DC connections, consisting of ground, power, and control wires, exiting from the other end.
8. Control module shall be sized to fit inside a standard 4" x 4" junction box.
9. Control module shall be equipped with a 1/2" EMT threaded male fitting on the line voltage end, such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external.
10. Control module shall be equipable with accessory 1/2" EMT threaded male fitting on the low voltage end, such that it may be mounted to the inside of a ballast cavity with the box and line voltage wiring internal to the cavity and the low voltage wiring external.
11. Slave module shall be available for switching additional circuits. Slave module has same construction and specifications as control module except without power supply function.
12. Subject to compliance with the above requirements, provide models of one of the following:
 - a. Hubbell-CU Series
 - b. Sensor Switch-MP20 Series
 - c. Wattstopper-BEP Series
 - d. Mytech-MP Series
 - e. Greengate SP20-MV Series
 - f. Leviton – OSC/OSA Series
 - g. Douglas – WP-PP

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

- A. Install occupancy 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.
- B. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.
- 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. Contractor shall be on site as required, to adjust lighting control units for proper operation.
- E. Mount the switchpack in a standard 4" junction box. Mount sensor to a standard 4" junction boxes. Refer to manufacturer supplied mounting instructions.
- F. Spare Parts: Refer to Section 26 0502 for requirements.

3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.

- B. System start-up: Provide a factory authorized technician to verify the installation and test the system.
- C. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. Contractor shall visit the job site 3 months after the owner has taken occupancy and adjust any units not operating properly, otherwise remove and replace with new units.

3.3 PRODUCT SUPPORT AND SERVICES:

- A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
 - 1. The sensors have been fully installed in accordance with manufacturer's installation instructions.
 - 2. Low voltage wiring for overrides and sensors is completed.
 - 3. Accurate 'as-built' load schedules have been prepared.
 - 4. Proper notification of the impending start-up has been provided to the owner's representative.
 - 5. Programming of all switches, sensors, power packs, relays, etc. shall be completed by factory authorized technician, prior to final and training.
- B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.
- C. Functional Testing:
 - 1. The owner shall hire a third party that will conduct and certify the functional testing.
 - 2. Lighting controls devices shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working conditions in accordance with the construction documents, manufacturer's instructions and code requirements. The following shall be performed:
 - a. Certify that sensors have been located, aimed and calibrated per manufacturer recommendations.
 - b. Status indicator operates properly.
 - c. Fixtures that are controlled by auto-on controls turn on to permitted level.
 - d. Fixtures that are controlled by manual on controls operate when manually activated.
 - e. Fixtures do not turn on incorrectly due to HVAC or movement outside the controlled area.

- f. Confirm that occupancy sensors turn off after space is vacated and do not turn on unless space is occupied.
- g. Simulate unoccupied conditions and confirm that vacancy sensors only turn on manually and turn off after space is vacated.
- 3. The party responsible for the functional testing shall provide documentation that the installed lighting controls meet or exceed all performance criteria and shall not be directly involved in the design or construction of the project.

3.4 WARRANTY:

- A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.5 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

3.6 TRAINING

- A. Provide four (4) hours of video taped training in two 2 hour sessions on the operation and use of the lighting control equipment, at job site, at no cost to the Owner.

3.7 MANUFACTURER AUTHORIZED PERSONNEL TRAINING:

- A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating lighting control system equipment.

END OF SECTION 26 0923

BLANK PAGE

SECTION 26 0943 - LIGHTING CONTROL EQUIPMENT
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

- 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, lighting control panels, control stations and other user interface devices, wiring and ancillary equipment.
- B. Types of lighting control equipment specified in this section, includes the following:
 - 1. Low voltage room controller panels
 - 2. Wall stations
 - 3. Occupancy sensors
 - 4. Daylight photosensor
- C. Requirements are indicated elsewhere in these specifications for work including but not limited to raceways, electrical boxes and fittings required for installation of lighting control equipment, not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. To ensure a uniform installation and single responsibility, all switching and dimming equipment described herein shall be supplied by a single manufacturer.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with lighting control equipment installation work similar to that required for project.
- C. NEC Compliance: The control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.
- D. NEMA Compliance: The control system shall comply with all applicable portions of the NEMA Standard regarding the types of electrical equipment enclosure.
- E. Codes and Standards: Provide units that meet the requirements of IEEE Std. 2000.1.1999.
- F. Independent Testing Laboratory: Provide units that have been tested and listed under UL 916 energy management equipment.

- G. Component Pre-testing: All control equipment shall undergo strict inspection standards. The equipment shall be previously tested and burned-in at the factory prior to installation.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide lighting control equipment of one of the following;
 - 1. [Greengate Lighting Control](#)
 - 2. [Lighting Control & Design](#)
 - 3. [Lutron](#)
 - 4. [Nexlight](#)
 - 5. [Wattstopper](#)
 - 6. [Hubbell Automation](#)

2.2 SYSTEM DESCRIPTION

- A. The lighting control system shall provide seamless control and monitoring of all lighting included in the scope of work regardless of whether it is relay switched or dimmed.
- B. The lighting control system shall consist of low voltage relay control panels with programmable switch inputs, the panel shall be microprocessor controlled with a touchscreen interface display. The touchscreen shall provide relay status information viewable through a protected windowed enclosure. All local programming shall be permissible through the self-prompting touchscreen.
- C. Programmable intelligence shall include:
 - 1. Time of day control (64 time-of-day/holiday schedules)
 - 2. 32 holiday dates
 - 3. Timed inputs (adjustable from 1 to 99 minutes)
 - 4. Timed override (from touchscreen, adjustable from 1 to 999 minutes, then resumes normal schedule)
 - 5. Pre-set controls
 - 6. Auto daylight savings adjust
 - 7. Astronomical clock with offsets
 - 8. Local control (from touchscreen and local switch)
 - 9. Digital switches
 - 10. Flash warning of impending off for occupants
 - 11. Network override
- D. The controller shall permit lighting to be overridden on for after-hours use or cleaning. The

controller shall provide priority and masking choices to allow for customizing the functions of switch inputs, thereby enabling switches to function differently at different times of day. These overrides shall be digital, network or hard-wired inputs.

- E. The lighting control system shall be fully programmable through PC programming software. Programming shall be permitted through a direct RS-232 connection, modem or TCP/IP.
- F. The control system shall provide networking between lighting control panels. The network shall support up to a maximum of 254 control panels. Panels shall permit data sharing for global controls. All inputs shall be transferable over the network to create any switching pattern.
- G. The lighting control system shall log all control events. Log reports shall be available through the integral touchscreen or enterprise software.

2.3 EQUIPMENT

- A. Room Controllers:
 - 1. The room controller shall provide the following functionality;
 - a. Provide interface with room occupancy sensor to provide lighting control and be programmable as either manual on/automatic off or automatic on/automatic off (automatic on shall not allow lighting to exceed 50% level). Provide interface with room wall stations to provide multi-level switching and/or variable dimming. Provide interface with daylight photosensors to provide daylighting controls of lighting fixture via multi-level (step dimming) and/or variable dimming.
 - 2. Provide with network interface to tie to building relay panel
 - 3. The room controller shall be a fully functional lighting control system to match the room lighting and control requirements. The controller shall provide the following features:
 - a. Separate compartments for line voltage, emergency voltage and low voltage connections.
 - b. Breakouts for direct conduit connections.
 - c. Dual voltage (120/277 VAC)
 - d. Low voltage connections using standard RJ-45 connectors.
 - e. Zero cross circuitry for each load.
 - f. Relay and 0-10V dimming zone configuration to match room requirements.
 - 4. Emergency Lighting: When the room controller is provided with emergency relay, the controller shall be UL 924 Listed and monitor the normal power circuit. The UL 924 relay will track the normal power operation. Upon loss of normal power the emergency lighting will be forced on to full bright (if dimming) until normal power is restored. The following features shall be included:
 - a. 120/277 VAC
 - b. Push-to-test
 - 5. Daylight photo sensors shall work with the room controller to provide automatic

daylight dimming capabilities for loads connected to the room controller. The daylight sensor shall include the following features:

- a. An additional photodiode that measures only the visible spectrum.
 - b. The sensor shall have three light level ranges;
 - i. Low (3-300 LUX), high (30-3000 LUX) and direct sun (300-30,000 LUX).
 - c. The sensor shall provide the capability of controlling multiple (up to three) daylight zones for dimming daylight harvesting.
 - d. The sensor shall include an internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
6. Ceiling Mounted Occupancy Sensors: Sensors shall utilize dual-technology (ultrasonic and infrared technologies) and have the following additional features:
- a. Sensor shall be class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
 - b. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
 - c. Sensor shall have 360 degree field of view.
 - d. Sensor shall incorporate non-volatile memory such that all settings and parameters are saved in protected memory.
 - e. Sensor shall have time delays from 10 to 30 minutes.
 - f. Sensor shall provide a visual means of indication that motion is being detected via an LED.
 - g. Sensors shall have readily accessible, user adjustable settings for time delay and sensitivity.
7. Wall Stations: Provide low voltage momentary push-button switches up to 6 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wall station shall connect to the room controller via the room controller local network.

PART 3 - EXECUTION:

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

- A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.
- B. Comply with Requirements of NEC, and applicable portions of NECA's 'Standard of Installation' pertaining to general electrical installation practices.
- C. Coordinate with other electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- D. Electrical Identification: Refer to Section 26 0553 for requirements.

3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.
- B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.3 PRODUCT SUPPORT AND SERVICES:

- A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
 - 1. The control system has been fully installed in accordance with manufacturer's installation instructions.
 - 2. Low voltage wiring for overrides and sensors is completed.
 - 3. Accurate 'as-built' load schedules have been prepared for each lighting control panel.
 - 4. Proper notification of the impending start-up has been provided to the owner's representative.
 - 5. Programming of all switches, relays, groups of relays shall be completed by factory authorized technician, prior to final and training.
- B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.

3.4 WARRANTY:

- A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.5 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

3.6 TRAINING

- A. Provide four (4) hours of video taped training in two 2 hour sessions on the operation and use of the lighting control equipment, at job site, at no cost to the Owner.

END OF SECTION 26 0943

BLANK PAGE

SECTION 26 2726 - WIRING DEVICES
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

- 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 that are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Receptacles
 - 2. Switches
 - 3. Cord caps
 - 4. Cord connectors

1.3 QUALITY ASSURANCE:

- A. Comply with NEC and NEMA standards as applicable to construction and installation of electrical wiring devices. Provide electrical wiring devices that have been UL listed and labeled.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES:

- A. GENERAL:
 - 1. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub No. WD 1.
- B. Provide wiring devices (of proper voltage rating) as follows:

	<u>RECEPTACLE</u>	<u>SWITCHES</u>			
<u>MFGR</u>		<u>1-POLE</u>	<u>3-WAY</u>	<u>4-WAY</u>	<u>W-PILOT</u>
Hubbell	HBL 5352	HBL 1221	HBL 1223	HBL 1224	HBL 1221-PL
Bryant	5352	1221	1223	1224	1221-PL
Pass Seymour	5352	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	5362	1221	1223	1224	

Cooper	5352	1221	1273	1224	1221-PL
--------	------	------	------	------	---------

- C. Provide devices in colors selected by Architect. Provide red devices on all emergency circuits.
- D. **GROUND-FAULT INTERRUPTER:**
 - 1. Provide general-duty, duplex receptacle, ground-fault circuit interrupters; feed-thru types, capable of protecting connected downstream receptacles on single circuit; grounding type UL-rated Class A, Group A, 20-amperes rating; 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliampere ground-fault trip level; color as selected by Architect. Provide Hospital grade where required elsewhere by specification or drawings. Provide units of one of the following:
 - a. P&S/Sierra
 - b. Hubbell
 - c. Leviton
 - d. Square D
- E. **CORD CAPS AND CONNECTORS:**
 - 1. Provide 3, 4 and 5-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment, and as indicated otherwise on drawings.
 - 2. Provide products of one of the following:
 - a. Cooper
 - b. General Electric
 - c. Hubbell
 - d. Leviton
 - e. P&S

2.2 WIRING DEVICE ACCESSORIES:

- A. **WALL PLATES:**
 - 1. Provide coverplates for wiring devices; plate color to match attached wiring devices. Provide stainless steel coverplates in all finished areas. Provide galvanized steel plates in unfinished areas. Provide blank coverplates for all empty outlet boxes.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical box and wiring work, as necessary

to interface installation of wiring devices with other work. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices, equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings before beginning rough-in of electrical work. Adjust locations of all electrical outlets as required to accommodate work in area, and to avoid conflicts with wainscoat, back splash, tackboards, and other items.

- C. Provide receptacles in surface raceway at 18" on center unless indicated otherwise.
- D. Install wiring devices only in electrical boxes that are clean; free from excess building materials, dirt, and debris.
- E. Install blank plates on all boxes without devices.
- F. Delay installation of wiring devices until wiring work and painting is completed. Provide separate neutral conductor from panel to each GFI receptacle.
- G. Install GFI receptacles for all receptacles installed in the following locations:
 - 1. Restrooms, locker rooms, kitchens, within 6 feet of any sink, or when serving vending machines and electric drinking fountains.
 - 2. Indoor wet locations, non-dwelling garages, elevator rooms and pits.
- H. Where light switches or wall box dimmers are specified, provide a separate neutral for each phase of the branch circuits that switches or dimmers are connected.
- I. Electrical Identification: Refer to Section 260553 for requirements.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES:

- A. At time of substantial completion, replace those items, that have been damaged, including those stained, burned and scored.

3.3 GROUNDING:

- A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated.

3.4 TESTING:

- A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 26 2726

BLANK PAGE

SECTION 26 2815 - OVERCURRENT PROTECTIVE DEVICES
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of overcurrent protective device work is indicated by drawings and schedules and specified herein. Overcurrent protective devices specified herein are for installation as individual components in separate enclosures; and for installation as integral components of switchboard and panelboards. See Section 262413, Switchgear and Switchboards, and Section 262416, Panelboards.
- B. Types of overcurrent protective devices in this section include the following for operation at 600 Volts and below:
 - 1. Molded case thermal circuit breakers
 - 2. Fusible switches
 - 3. Fuses
- C. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices.

1.3 QUALITY ASSURANCE

- A. Comply with NEC requirements and NEMA and ANSI standards as applicable to construction and installation of overcurrent devices.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following (main and branch device manufacturer must be same as panelboard and/or switchboard manufacturer):
- B. CIRCUIT BREAKERS AND FUSIBLE SWITCHES:
 - 1. GE/ABB
- C. MOLDED CASE THERMAL TRIP CIRCUIT BREAKERS:
 - 1. Provide factory-assembled, molded case circuit breaker for power distribution panelboards and switchboards; and for individual mounting, as indicated. Provide breakers of amperage, voltage, and RMS interrupting rating shown, with permanent thermal trip and adjustable instantaneous magnetic trip in each pole.

Series rated systems are not acceptable. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with mechanical screw type removable connector lugs, AL/CU rated, of proper size to accommodate conductors specified.

2. Circuit breakers 15 amps through 599 amps shall be molded case thermal trip circuit breakers.

D. FUSIBLE SWITCHES:

1. Provide factory-assembled fusible switch units for power distribution panelboards and switchboards, and individual mounting as indicated. Provide switch units of amperage, voltage, and RMS interrupting rating as shown, with quick-make, quick-break mechanisms, visible blades and dual horsepower ratings. Series rated systems are not acceptable. Equip with lockable handles with on-off indication. Interlock switch covers and handles to prevent opening in "ON" position. Provide switch with Class R rejection fuse clip kits. Provide AL/CU rated lugs of proper size to accommodate conductors specified.

2.2 FUSES

- A. GENERAL: Except as otherwise indicated, provided fuses of type, sizes and ratings and electrical characteristics of a single manufacturer as follows. Provide fuses labeled UL Class L or UL Class R, current limiting and rated for up to 200,000 amperes. Provide Buss KAZ signal activating fuses where required elsewhere in specification.
- B. Where fuses are shown feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing; adjust fuse size and type as necessary to comply with manufacturer's recommendation.
- C. Provide and install spare fuse cabinet in main electrical room.
- D. BRANCH CIRCUITS: For motor circuits, transformer circuits, or other inductive loads, provide UL Class RK5 (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECN-S or FLN-R, FLS-A). For other circuits, provide UL Class RK1, (KTN-R, KTS-R OR A2K-R, A6K-R or NCLR, SCLR OR KLN-R, KLSR).
- E. MANUFACTURER: Subject to compliance with requirements, provide fuses of one of the following:
 1. Bussman Mfg. Co.
 2. Mersen (Ferraz Shawmut)
 3. Reliance Fuse Div./Brush Fuse Inc.
 4. Littlefuse, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES:

- A. Install overcurrent protective devices as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of

overcurrent protective devices.

- B. Coordinate with work as necessary to interface installations of overcurrent protective devices with other work.
- C. Install fuses in overcurrent protective devices. For motor circuits, fuse sizes shown on drawings are for general guidance only. Size fuses in accordance with fuse manufacturer's recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) as required to provide nuisance free tripping. Adjust fuse size properly for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times. Include all costs in bid.
- D. Electrical Identification: Refer to Section 260553 for requirements.

3.2 FIELD QUALITY CONTROL

- A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 26 2815

BLANK PAGE

SECTION 26 4119 - DEMOLITION
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Special Provisions, Division 1 and Division-2 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to demolition.

1.2 DESCRIPTION OF WORK:

- A. Extent of major items of demolition work is indicated by. Other demolition work shall be performed as required to maintain system operation.
- B. The intent of the drawings is to indicate major items affected and not to show every device, outlet, fixture, etc. affected by demolition work.
- C. The drawings do not necessarily reflect as-built conditions. The contractor shall visit the jobsite prior to bidding to determine the overall scope of demolition work.
- D. Refer to sections of other Divisions for applicable requirements affecting demolition work.
- E. Refer to Section 260500 for requirements with regard to power outages affecting the operation of existing electrical systems.

1.3 QUALITY ASSURANCE:

- A. NEC COMPLIANCE:
 - 1. Comply with applicable portions of NEC as to methods used for demolition work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL:

- A. Demolition work shall be laid out in advance to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary, perform with care, use skilled mechanics of the trades involved. Repair damage to building and equipment. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting of structural members shall not be permitted.

3.2 PATCHING AND REPAIR

- A. The Contractor is responsible for all demolition, patching and repair of all finished interior surfaces pertaining to the installation of this particular phase of work. All surfaces shall be finished (painted, etc.) to match the adjacent materials, finishes and colors.
- B. Hard surfaces: Whenever demolition or excavation is required for the installation of the electrical system, it shall be the responsibility of this contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, roofing, etc.

- C. The method of patching and repair shall follow good construction practices and all finished surfaces shall match materials and finish wherein the demolition occurred.

3.3 EXISTING EQUIPMENT

- A. The following is a part of this project and all costs pertaining thereto shall be included in the base bid.
- B. The new electrical equipment and apparatus shall be coordinated and connected into the existing system as required. Auxiliary systems shall comply, unless otherwise specified.
- C. The existing electrical devices, conduit and/or equipment that for any reason obstructs construction shall be relocated. Provide conduit, wiring, junction boxes, etc. as required to extend existing circuits and systems to relocated devices or equipment.
- D. The new fixtures indicated for existing outlets shall be installed in accordance with the fixture specifications.
- E. When installing equipment in the existing building, it shall be concealed.
- F. All existing electrical equipment and systems in portions of the building not being remodeled shall be kept operational, in service and in working condition throughout the entire construction period. Restore any circuits and systems interrupted. Provide temporary panels, temporary wiring and conduit, etc. as required.
- G. Maintain circuit integrity and continuity of all existing circuits and systems that interfere with or are interrupted by remodel work unless those circuits are to be abandoned completely. Maintain all circuits and systems in operation during construction. Provide temporary panels, temporary wiring and conduit, etc. as required.
- H. Existing raceways may be used where possible in place, except as noted. All circuits, conduit and wire that are not used in the remodeled area shall be removed back to the panelboard, where it shall be labeled a spare with circuit number indicated. Re-used raceway shall meet all requirements for new installations.
- I. The existing light fixtures that are not used in the remodeled area shall be carefully removed, and properly disposed of.
- J. Obtain permission from the Architect and Owner's representative before penetrating any ceiling, floor, and wall surfaces.
- K. Any and all equipment having electrical connections that require disconnecting and reconnection at the same or another location throughout the course of construction shall be included as part of this contract.

END OF SECTION 26 4119

SECTION 26 5100 - INTERIOR AND EXTERIOR BUILDING LIGHTING
PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

- A. Types of lighting fixtures in this section are indicated by schedule and include the following:
 - 1. LED (Light Emitting Diode)

1.3 QUALITY ASSURANCE:

- A. Comply with NEC, NEMA and ANSI 132,1 as applicable to installation and construction of lighting fixtures. Provide lighting fixtures that have been UL-listed and labeled.
- B. Components and fixtures shall be listed and approved for the intended use by a National Recognized Testing Laboratory (NRTL) including: UL, ETL, and CSA or equivalent
- C. All led products shall comply with the latest version of Illuminating Engineer Society (IES) publications LM-79 and LM-80.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):
 - 1. LED:
 - a. Cree
 - b. Nichia
 - c. Samsung
 - d. Philips Lumiled
 - e. Osram
 - f. Xicato

2.2 INTERIOR AND EXTERIOR LIGHTING FIXTURES:

- A. GENERAL:
 - 1. Provide lighting fixtures, of sizes, types and ratings indicated complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, LED drivers, starters, and wiring. Label each fixture with manufacturer's name and

catalog number. Provide all enclosed fixtures with positive latch mechanisms; spring tension clips not acceptable. Provide all exterior fixtures with damp or wet location label as required by application.

B. SUPPORT REQUIREMENTS:

1. Provide all pendant and stem hung fixtures with flexible ball joint hangers at all points of support. Equip hooks used to hang fixtures with safety latches. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain, or safety cable.

C. LIGHT EMITTING DIODE (LED) LUMINAIRES:

1. LED luminaires that can be serviced in place shall have a disconnecting means internal to the luminaires to disconnect simultaneously from the source of supply all conductors of the driver, including the grounded conductor. Disconnects shall not be required under the following exceptions:

- a. Luminaires located in hazardous locations.
- b. Luminaires used for egress lighting.
- c. Cord-and-plug luminaires.
- d. In industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.
- e. Where more than one luminaire is installed in a space and where disconnecting the supply conductors to the luminaire will not leave the space in total darkness.
- f. Provide LED luminaires which are tested in accordance with IES LM-79, diodes tested in accordance with IES LM-80, and provide a minimum R9 rating of ≥ 50 (unless specified differently), a CRI rating of ≥ 80 and L70 (6K) = 50,000 hours (IES TM-21). Provide with 0-10V dimming drivers as standard.
- g. The fixture manufacturer(s) shall warrant the luminaires, in their entirety, to be free from defects in material or workmanship for at least 5 years from date of manufacture. Provide warranty in accordance with other sections of this specification and include a certificate of warranty from the fixture manufacturer with extended warranty information and proper forms and procedure description.

D. DIFFUSERS:

1. Where plastic diffusers are specified, provide 100 percent virgin acrylic compound; minimum thickness, .125 inches.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

- A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standards

- of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other work as appropriate to properly interface installation of lighting fixtures with other work. Consult architectural reflected ceiling plan for exact location of all lighting fixtures.
 - C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of fixtures. Support all ceiling mounted fixtures from the building structure; independent of the ceiling system, unless noted. Support each recessed fixture (fluorescent incandescent, and/or HID) from the building structure with #12 ga. steel wire attached to each corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support surface mounted ceiling fixtures from channel. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. Feed each recessed fixture directly from an outlet box with flex conduit as required; do not loop from fixture to fixture. See plans for additional details.
 - D. **FIXTURE WHIPS:**
 - 1. Provide each lay-in light fixture with at least 36" (Not to exceed 72") of 3/8" steel flexible conduit.
 - 2. With-in spaces utilizing 0-10v control schemes ie: Room Controllers, the fixture whip shall be comprised of a MC-PCS Cable (see Section 26 0532 Conduit raceways) with at least 36" and not to exceed 72" in length located above removable grid ceilings.
 - E. Coordinate lighting in mechanical room with duct and equipment locations to avoid obstruction of illumination.
 - F. Provide gypsum board protection as required, (acceptable to fire official having jurisdiction) to ensure fire rating of each ceiling that the fixtures are installed in.
 - G. **COORDINATION MEETINGS:**
 - 1. Meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.
 - 2. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all fixtures and duct work in all areas.
 - H. **ADJUST AND CLEAN:**
 - 1. Clean lighting fixtures of dirt and debris upon completion of installation.
 - 2. Protect installed fixtures from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish.
 - I. **SPARE PARTS:** Refer to Section 26 0502 for requirements.

3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.

- B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.
- C. At the time of Substantial Completion, replace lamps in interior lighting fixtures that are observed to be noticeably dimmed after the Contractor's use and testing, as judged by Architect/Engineer.
- D. GROUNDING:
 - 1. Provide equipment grounding connections for each lighting fixture.

END OF SECTION 26 5100

SECTION 27 1500 - TELEPHONE DATA SYSTEMS
PART 1 – GENERAL

1.1 SCOPE OF DOCUMENT:

- A. The following are project specifications that all cabling systems must adhere to. These specifications apply to all installers (hereinafter referred to as “the Contractor”) for all sites, that require, standards-compliant structured cabling systems and shall be used for all the installation, testing, and acceptance of the information transport systems as described in the attached specifications. Prices quoted of the installation facilities shall be all-inclusive and represent a complete installation at such sites as prescribed in this specification and contract documents. The Contractor shall be solely responsible for all parts, labor, testing, acceptance and all other associated processes and physical apparatus necessary to turn-over a completed system fully warranted and operational for acceptance by the Customer. Final acceptance of the installation shall be in writing by the Architect and Engineer.
- B. In all instances where Standards are cited, it is assumed Installer will have familiarity with and implicitly follow the recommendations of the most current version of the Standard referenced at the time of installation. Compliance with most current Standards is the sole responsibility of the Contractor.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-7 Firestopping, apply to work of this section.
- C. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.3 SCOPE OF WORK:

- A. The extent of telephone/data system work is indicated by drawings and is hereby defined to include, but not be limited to racks, cabinets, patch panels, cables, raceway, outlet boxes, device plates, backboard, and grounding. Contractor is responsible for installation of all specified and unspecified necessary and miscellaneous items required for delivery of a complete and functional data cabling and device system.
- B. Contractor shall provide complete cable and outlet system as indicated on the drawings and described herein. Work shall include all associated infrastructure transmission components and support appliances including, but not be limited to cable, jacks, terminal blocks, racks, cabinets, wire management, labeling, transient voltage surge suppression, patch cords, telecommunications grounding system and all terminations as specified herein.
- C. Contractor shall provide system testing as described herein using up-to-date and industry accepted Level IIIe test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1. All testers used shall be factory calibrated within one year of use with references set daily prior to testing.
- D. All active equipment (electronics) will be owner furnished and owner installed.
- E. Contractor shall be solely responsible for all parts, labor, testing, documentation and all

other associated processes and physical apparatus necessary to turn-over the completed system fully warranted and operational for acceptance by Owner and Engineer.

- F. Contractor shall provide all labor, materials, tools and equipment required for the complete installation of work called for in the Construction Documents.
- G. Copper solution must match optical fiber solution and be provided by the same manufacturer. No two separate warranties are acceptable for the copper connectivity and optical fiber connectivity.

1.4 CONTRACTOR QUALIFICATIONS

- A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to voice and data network systems. The Contractor shall at a minimum possess the following qualifications:
 - 1. Must have at a minimum (1) RCDD certified individual employed full time at the time of bidding and throughout entire project. PROVIDE PROOF OF RCDD CERTIFICATION IMMEDIATELY UPON JOB AWARD.
 - 2. Approved and certified by connectivity manufacturer. Provide proof of certification immediately upon job award.
 - 3. BICSI Certified Installers or equivalent.
 - 4. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
 - 5. Have a minimum of 5 years in the communications structured cabling business and be able to provide three owner references for the type of installation described in this specification for projects within the last 18 months.
 - 6. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must own not rent a light meter or fiber test adapter head, and OTDR and shall be factory certified by the manufacturer of the products being installed.
 - 7. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.
 - 8. Personnel knowledgeable in local, state, province 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 be followed.
 - 9. Be factory certified by the manufacturer used in installation of all transmission components of all copper and fiber links and able to provide the manufacturer warranty.
- B. Approved Contractor:
 - 1. Americom

1.5 QUALITY ASSURANCE

- A. Required Pre-Telecommunications Construction Meeting with Communications Engineer: Electrical contractor/representative AND Communications Contractor will be required to attend a pre-communications construction meeting (approximately 30-60 minutes) with

Communications representative in the electrical engineer's office prior to communications construction commencement. This meeting will address any questions on the part of the contractor and the expectations of the Engineer with regard to specifications, plans and site visits for both rough and finish electrical work.

- B. BNA IT Contact:
1. Brian Hicks RCDD; bhicks@bnaconsulting.com, 801-532-2196
 2. Josh Oakeson RCDD; josh@bnaconsulting.com, 801-532-2196
 3. Son Nguyen; snguyen@bnaconsulting.com, 801-532-2196

1.6 APPLICABLE CODES AND STANDARDS

- A. Contractor is responsible for compliance with all applicable portions of the NEC code as to type of products used and installation of components. All materials used shall be products and materials that have been UL-listed and labeled. All installed products shall comply with applicable NEMA standards for low loss extended frequency cable.
- B. In addition, installation shall adhere to the following Standards:
1. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises, or most recent edition at the time of installation
 2. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standards, or most recent edition at the time of installation
 3. ANSI/TIA-568-C.2 - Balance Twisted Pair Communications and Components Standards, or most recent edition at the time of installation
 4. ANSI/TIA –942 -Telecommunications Infrastructure for Data Centers, or most recent edition at the time of installation
 5. TIA-569-B - Commercial Building Standard for Telecom Pathways and Spaces, or most recent edition at the time of installation
 6. ANSI/TIA-606-A – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, or most recent edition at the time of installation
 7. ANSI/NECA/BICSI-607 - Commercial Building Grounding/Bonding Requirements, or most recent edition at the time of installation
 8. ANSI/TIA 1152 – Testing of Copper Links
 9. BICSI Telecommunications Distribution Methods Manual, 13th edition or most recent edition at the time of installation.
 10. TIA 758-A - Customer owned Outside Plant Telecommunications Infrastructure Standard (2004), including all applicable addenda and the most recent revision at the time of installation.
 11. BICSI Information Transport Systems Installation Manual - 5th edition or most recent edition at the time of installation.
 12. ANSI/NFPA-70 - 2017 National Electrical Code, revision, or most recent revision at the time of installation.

13. ANSI/IEEE C-2 - 2017 National Electrical Safety Code or most recent revision at the time of installation.
14. OSHA Standards and Regulations All applicable
15. Local Codes and Standards All applicable

C. Note: Anywhere 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 Installer. Any code violations shall be remedied at the Contractor's expense.

1.7 ACCEPTABLE MANUFACTURERS:

A. General:

1. Unapproved product substitutions are not allowed. Contractor wishing to substitute any products for those expressly specified shall submit three samples of the alternate product to Engineer no less than two weeks prior to the last addendum accompanied by all engineering documents, drawings and third party test data proving mechanical and transmission equivalency. Acceptance of substitutions shall be received from Engineer in writing. All unapproved substitutions installed shall be removed by Contractor who shall assume all costs for removal and replacement with approved products. Such costs shall include, but not be limited to labor, materials, as well as any penalties or fees for late completion.

B. APPROVED MANUFACTURERS:

1. Contractor shall select only one line item in the each section of Parts 2, 3, and 4. Contractor shall NOT utilize multiple line items for the project within each Part. For example, if Panduit / General Cable is selected to be used for the project, all copper cabling and connectivity shall be by Panduit or General Cable. No other manufacturer or combination of manufacturers may be used for the copper cabling or connectivity equipment.
2. Copper Cabling / Connectivity Approved Manufacturers:
 - a. CommScope
3. Non-Cabling / Connectivity Approved Manufacturers:
 - a. Same manufacturer from Part 2.
 - b. Chatsworth

1.8 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All products shall be in new condition and UL listed.
- B. Provide complete raceway, outlet boxes and miscellaneous items. All conduit utilized shall be EMT grade.

- C. Provide 5" x 2.875" (or 4-11/16" x 3.25" square) deep square outlet box at each outlet location with single gang plaster or tile ring. Provide wall board adapters / accessories as necessary.
 - 1. Approved solutions:
 - a. RANDL 5 Square Telecommunications Outlet Box Model TX-550-YY where "X" could be a bracket box and "YY" could be knockout arrangements.
 - b. Hubbell Large Capacity Wall Box Model HBL260. If a 2" knockout is required for installation purposes, provide this box.
- D. Communication grounding and bonding shall be constructed and installed to meet or exceed the requirements of the National Electrical Code (NEC), IEC 1000-5-2 and ANSI/J-STD--607-A throughout the entire grounding system.
- E. All termination hardware shall be rated to meet specified cabling specifications.

48-Port Patch Panel Cat 6		
<u>Manufacturer</u>	<u>Model Name</u>	<u>Flat Patch Panel</u>
CommScope	Systimax	360-IPR-MFTP-E-HD6B-2U-48

- e. Vertical Cable Managers:
 - i. Provide a vertical cable management panel on both sides of rack.
 - ii. Manager shall consist of a metal backbone with cable management fingers that align with EIA rack spacing. Provide cover for all cable management.
 - iii. Vertical panel shall be able to manage all the cable on the rack without the aid of horizontal cable managers.
 - iv. Size all vertical cable managers according to factory recommendations for the cable being installed. In no case shall design require more than 35% fill ratio when rack is fully populated.
 - v. Provide molded plastic slack spools in front to facilitate minimum bend radius compliance.
 - vi. Minimum width to be 6".
 - vii. Approved Equipment
 - 1. CommScope VCM-DS-84-xB (6", 8", 10", 12").
- f. Horizontal Cable Management
 - i. Provide horizontal cable management capable of managing copper and fiber cables.

- ii. Manager shall consist of bend radius control throughout the fingers, pass through holes, and transitions between horizontal and vertical pathways.
- iii. Provide front hinged cover that shall open 180 degrees.
- iv. Manager should mount to standard EIA 19" rack.
- v. Size according to factory recommendations for the cable being installed. In no case shall design require more than 40% fill ratio when rack is fully populated.
- vi. Approved Equipment

1. CommScope HTK-19-SS-XU, where X refers to the size.

2.2 CABLING DISTRIBUTION SYSTEMS AND MISCELLANEOUS EQUIPMENT

A. General:

- 1. Provide plenum rated cable/connectors if required, cabling/connectors must be appropriate for the environment that it is installed in. Provide wet rated cable for all wet locations, including any conduit in or below slab on grade.
- 2. Contractor shall be responsible for sizing all pathways such that newly installed cable represents not more than a 35% fill as per manufacturer's directions. Overfilled pathways are the sole responsibility of the Contractor who shall remove and reinstall at Contractors expense.

B. Horizontal Cabling Distribution System – Balanced Twisted Pair

1. General:

- a. Provide and install appropriate number of Category 6 horizontal cables, patch cables, work area cables, for all terminated data drops, between switches, etc. so that building-wide networking will be operational once all installation is complete.

2. Horizontal Cabling

- a. Provide Cat 6 UTP, min-compliant, 4-Pair 100Ω Balanced Twisted Pair Cable to all locations shown on plans.
- b. Provide cabling rated for the environment that it is installed in (i.e underground conduit, conduit in slab on grade). All cabling installed in wet locations shall be listed for use in wet locations.
- c. Provide a minimum of (2) cables, unless otherwise noted, to each location shown on plans.
 - i. Provide (2) Category 6A cables to each wireless access point (WAP).
- d. Horizontal cable shall be blue.
- e. Approved Equipment

<u>Cat 6</u>			
<u>Manufacturer</u>	<u>Model</u>	<u>Riser</u>	<u>Plenum</u>

CommScope	Uniprise	65N4	CS37P BLU
-----------	----------	------	-----------

- f. Field Terminable Plug (FTP)
 - i. Provide an FTP for each WAP. Provide and two FTPs for each WAP. Confirm FTPs are compatible with WAPs.
- 3. Patch and Work Area Cables:
 - a. Provide and install (1) 7-foot-long patch cable for each workstation and 7 foot patch cable for each patch panel port in the TR/TC.
 - b. No patch or work area cords shall in any case exceed in total 10 meters as per TIA Standard unless design includes Standards compliant MUTOA (multi-user termination outlet) and work area cord adjustments are made according to recommendations for zone cabling contained within TIA 568-C or most recent revision at the time of installation. Coordinate with owner for preferred patch cord lengths at patch panel and work area.
 - c. Copper patch cord and work area outlet cabling must be provided by the same manufacturer and meet the same performance standards as the horizontal cabling.
 - d. Patch cord and work area cables shall be blue.
- 4. Telecommunications Outlets/Connectors (See Plans for Locations):
 - a. Sloped Faceplates:
 - i. Provide modular type information outlets with sloped telephone jack or data outlet. Provide single gang faceplate kits to allow up to six data or voice jacks as shown on plans. Provide faceplate kits for wall outlets in colors and materials that match power wiring device plates. Provide faceplate kits that allow labeling schemes described herein. Faceplates shall accept STP, UTP, fiber optic or audio/video modules as an option.
 - ii. Blank off all unused ports.
 - iii. Color: Standard color as selected by owner/architect.
 - b. Angled Connector:
 - i. Color: Standard color as selected by owner/architect.
 - c. Approved equipment

<u>Manufacturer</u>	<u>Model</u>	<u>Connector Cat 6</u>
CommScope	Uniprise	UNJ10G-BL

<u>Manufacturer</u>	<u>Model</u>	<u>Stainless Steel Faceplates</u>

CommScope	Systimax	M12SP
-----------	----------	-------

PART 3 – EXECUTION

3.1 GENERAL

- A. Prior to pathway rough-in, low voltage contractor shall meet with electrical contractor to review pathway installation requirements.
- B. Pathway Requirements:
 - 1. General:
 - a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.
 - b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Arrangements to remove any major obstructions not identified on plans need to be determined at that time with the Engineer.
 - c. Paint all electrical boxes and their covers for the telephone and data system green (Kwal Paint Java Green AC098N).
 - 2. Cable Tray Within EF/ER/TR:
 - a. Wrapped around room (wall support is acceptable)
 - b. Along equipment rows leading to cross-connects.
 - c. Ground tray to TGB or TMGB (whichever is closer) utilizing #6CU bare wire.
 - d. Coordinate tray locations with lighting, air-handling systems, and fire extinguishing systems so that fully loaded trays will not obstruct or impede their operation.
 - 3. Racks / Cabinets:
 - a. Racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.
 - b. Racks shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
 - 4. Conduits:
 - a. For any interior/exterior conduit 4" and larger, provide (3) 1.25" plenum-rated corrugated innerducts.
 - b. Flexible conduit is not acceptable as cable tends to creep, shift, or have sheath damage.

- c. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
 - d. Conduit runs shall not have continuous sections longer than 100 feet without a pull box and may only be filled to 35% capacity.
 - e. Ream all conduit ends and fit with an insulated throat nylon bushing with non-indenter type malleable steel fittings to eliminate sharp edges.
 - f. Telecommunications conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.
 - g. Conduits that enter an EF/ER/TR must terminate near the corners to allow for proper cable racking. Terminate these conduits as close as possible to the wall where the backboard is mounted to minimize the cable route.
 - h. Terminate conduits that protrude through the structural floor 1" to 3" above the surface within an EF/ER/TR.
 - i. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.
 - j. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.
 - k. When the number of conduits requires more than one row, restrict the number of rows to two wherever practicable.
5. Pull Box Requirements:
- a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.
 - b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90-degree bends, or contain a reverse bend.
 - c. Conduits that enter the pull box from opposite ends should be aligned.
 - d. Pull boxes shall have a length 12 times the diameter of the largest conduit.
 - e. All pull boxes must be accessible.
- C. Cabling System:
- 1. Follow T568B scheme for copper cabling terminations.
 - 2. Life Safety Related Cabling:
 - a. Provide the specified category cabling in 1" conduit for two phone lines to the fire alarm control panel back to telephone service demarcation point.
 - b. Provide the specified category cabling in 1" conduit for the two-way communication system Main Control Panel back to telephone service demarcation point.

3. Miscellaneous Related Cabling:
 - a. Provide the specified category cabling in 1" conduit for two data connections to Access Controls System head-end back to closest data rack. Refer to plans for exact locations.
 - b. Provide the specified category cabling in 1" conduit for one data connection to Intercom head-end back to closest data rack. Refer to plans for exact locations. Provide specified category cabling and conduit between intercom head-end and access control panel.
 - c. Provide the specified category cabling in 1" conduit for Main Building Management System (ATC Panels, etc) back to nearest ER/TR room. Refer to Mechanical plans for exact location.
4. Provide a minimum of one balanced twisted pair cable to each voice outlet and one balanced twisted pair cable to each data outlet shown on the drawings unless noted otherwise on the drawings.
5. Provide a minimum 6" service loop in each communications system junction box for balanced twisted pair. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.
6. Provide a minimum 10' service loop in each EF/ER/TR/TE.
7. Provide a minimum 2' service loop at each stub-up or at each transition from conduit to cable tray.
8. Provide a 5' service loop in the ceiling before the conduit travels down the wall and terminates into the communications junction box.
9. Provide modular jacks for each installed cable at outlets shown on drawings. Blank off all unused ports on faceplate.
10. Provide Velcro type ties for all cables and install in a neat and workmanlike manner. Where applicable, use plenum rated Velcro. Where cable is installed in cable tray, bundle a maximum of 25 cables in each Velcro tie.
11. The bending radius and pulling strength requirements of all backbone and horizontal cables shall be observed during handling and after installation. Use pulling compound as recommended by manufacturer.
12. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
13. The combined length of all patch cords in the EF/ER/TR and the work area shall not exceed 10m (33 ft)
14. No splices are allowed.
15. In a false ceiling environment, a minimum of 3 inches shall be observed between cable supports and false ceiling. At no point shall cable(s) rest on acoustic ceiling grids or panels.
16. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and

- support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
17. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
 18. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
 19. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
 20. Pair untwist at the termination shall not exceed 0.125". The cable jacket shall be maintained as close as possible to the termination point.
 21. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
 22. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.
 23. Copper Backbone Terminations:
 - a. Terminate one single pair on pins 4, 5 at each patch panel port.
Terminate all pairs on patch panel located on rack.
- D. Grounding System:
1. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
 2. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
 3. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
 4. All active equipment from owner shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
 5. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.
 6. Patch panels shall be bonded to racks using the appropriate bonding screws. Mounting rails may utilize cage nuts, threaded holes or thru hole mounting fasteners to secure patch panels to the rails.
 7. Bond cable tray, raceway system, structural steel and all other metal equipment

located within EF/ER/TR to the grounding bus bar utilizing copper conductors per the following schedule:

- a. $\leq 25'$ - #34
 - b. $\leq 50'$ - #2
 - c. $\leq 66'$ - #2/0
 - d. $\geq 67'$ - #3/0
8. Provide 4" X 12" X 1/4" CU Telecommunication Main Grounding Bus Bar (TMGB) with bonding conductor per schedule above to Intersystem Bonding Terminal (IBT) in each telecommunication room (EF/ER/TR) with a main cross-connect (MC). Provide 20% spare termination spaces on bus bar, provide additional bus bars as necessary to accommodate spare.
 9. Provide 2" X 12" X 1/4" CU Telecommunication Grounding Bus Bar (TGB) with bonding conductor per schedule above to TMGB in each room with a horizontal cross-connect (HC).
 10. Refer to electrical diagrams for additional ground connection requirements.
- E. Electromagnetic Compatibility:
1. General:
 - a. Do not install power feeders above or within the telecommunications room. Do not install telecommunications conduits above electrical panelboards, switchboards, transformers, motor control centers, etc.
 - b. Where telecommunication cable is installed in grounded, metallic conduit near power cables, the power cables shall be kept physically separated from telecommunications cables:
 - i. Circuits Under 5kVA: 2" minimum separation.
 - ii. Circuits Over 5kVA: 6" minimum separation.
 - iii. Electrical motors/transformers: 48" minimum separation.
 - iv. Lighting ballasts: 6" minimum separation.
 - c. Where telecommunication cable is installed in cable tray or underground in non-metallic conduit near power cables, the power cables shall be kept physically separated from telecommunications cables by a minimum of 12"
- F. EF/ER/TR Power Requirements:
1. General: Regardless of what is shown on drawings, the minimum requirements for providing power in the EF/ER/TR are as follows and shall be included in bid:
 - a. Two dedicated, nonswitched 120V/20A duplex receptacles, each on individual branch circuits.
 - b. 120V/20A Duplex receptacles located +6" A.F.F. placed at 6 foot intervals around perimeter walls. Up to 10 receptacles may be placed on a single circuit.
- B. Firestopping and Smoke/Acoustical Pathways(See Also Division 7):

1. Provide firestop/smoke barrier solution equivalent to the wall/ceiling/floor rating.
 2. Provide firestop labels next to each penetration with written date. Label both sides of the penetration.
 3. Firestop systems shall be UL Classified to ASTM E8124 (UL 1479). A drawing showing the proposed firestop system shall be provided to the Engineer prior to installing the Firestop system(s).
 4. Utilize firestop pass-through type devices for medium to large penetrations into fire walls/floors.
 5. Provide the following products:
 - a. Fire Rated; STI EZ-Path Fire-Rated Pathways Series (or Hilti Speed Sleeve CP 653 BA)
 - b. Smoke/Acoustical Rated; STI EZ-Path Smoke & Acoustical Pathway Series (or Hilti Smoke and Acoustic Sleeve CS-SL SA)
- G. Miscellaneous Equipment:
1. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.
 2. Provide patch cords and cross connect cables as necessary for a complete operational telephone and data network system. Consult with owner to determine any special needs such as dedicated phone lines.

PART 4 – LABELING

4.1 GENERAL

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All telecommunications spaces, pathways, cables, connecting hardware, equipment, racks, patch panels, outlet/connectors, and grounding system shall be labeled in accordance with TIA/EIA 606-A.
- C. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten, Ink, or Laser Printing labels are not allowed. Provide labels using thermal transfer print. Heat shrinking or wraparound labels are required, flag style labels are not allowed.

4.2 TELECOMMUNICATION PATHWAYS

- A. Identify each dedicated pathway (including inner ducts) for the voice and data system.
- B. Label pathways at regular intervals and wherever they are accessible.

4.3 TELECOMMUNICATION CABLES

- A. Identify cables at each end with a permanent label or physical/electronic tag.
 - 1. The same alphanumeric identifiers should be used at both ends of the cable.
 - 2. Identify cables at regular intervals throughout and wherever they are accessible.
 - 3. Cables shall be identified in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate that can be accessed by removing the cover plate and to the cable behind the patch panel on a section of cable that can be viewed without removing the bundle support ties. Cables labeled within the bundle where the label is obscured from view shall not be acceptable.

4.4 CONNECTING HARDWARE

- A. Identify connecting hardware items (termination blocks, cross-connects, racks, cabinets, patch panels, telecommunications outlet/connectors, ports) using alphanumeric identification such as the following three-level scheme:
 - 1. First level—Termination field or patch panel. Color-coding or other labeling should be used to uniquely identify each termination field (e.g., voice and data) on a common mechanical assembly.
 - 2. Second level—Terminal block within a given field or patch panel that could be a row of insulation displacement connectors (IDCs), optical fiber connectors, or modular jacks.
 - 3. Third level—Defines the individual position within a given terminal block or patch panel.

4.5 TELECOMMUNICATIONS GROUNDING SYSTEM

- A. Identify each telecommunications grounding bus bar (TGB) and telecommunications main grounding bus bar (TMGB).
- B. Identify each grounding conductor relating to the telecommunications system, including those connecting building steel, grounding electrodes, water pipes, and telecommunications structural components.

PART 5 - MISCELLANEOUS

5.1 TESTING:

- A. General
 - 1. Provide testing within 10 days of completion for all copper and fiber optic cable according to TIA/EIA standards and any other requirements of the manufacturer who will provide warranty.
 - 2. Submit copy of current calibration of all testing equipment. Submit all test reports electronically to architect/engineer and include in O&M manuals to include test reports. Meter shall have been calibrated within the past 12 months.

3. Correct any malfunctions. Contractor shall re-terminate/replace any cable, connection, or equipment found to be defective or non-compliant with these specifications and referenced standards.
 4. Invite Owner IT representative and Engineer to witness and/or review field testing. Notify five business days prior to commencing testing.
- B. Copper Cable
1. Utilize Level IIIe Tester to test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of industry accepted verification tests for the Category of cable installed and shall meet latest requirements of EIA/TIA cabling Standards.
 2. UTP Cable and Links: All UTP cabling channel must be tested at swept frequencies up to 250MHz for internal channel performance parameters as defined in IEEE 802.3an and ANSI/TIA/EIA-568C. Certifications shall include the following parameters for each pair of each cable installed:
 - a. Wire map (pin to pin connectivity)
 - b. Length
 - c. Insertion Loss
 - d. Near End Crosstalk (NEXT)
 - e. Attenuation to Crosstalk Ratio Far End (ACRF)
 - f. Return Loss
 - g. Propagation Delay
 - h. Delay Skew
 - i. DC Loop Resistance
 - j. DC Resistance Unbalance
 - k. Power Sum Near-End Crosstalk (PS-NEXT)
 - l. Attenuation to Crosstalk Ratio Near-End (ACR-N)
 - m. Power Sum Attenuation to Crosstalk Ratio Near-End (PS-ACR-N)
 - n. Attenuation to Crosstalk Ratio Far-End (ACR-F)
 - o. Power Sum Attenuation to Crosstalk Ratio Far-End (PS-ACR-F)
 - p. Transverse Conversion Loss (TCL)
 - q. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
 3. All channels that fail testing parameters will be replaced at the Contractor's expense until all channels pass the performance parameters.
 4. Provide Modular Plug Terminated Link (MPTL) test for all field terminated plugs (standard for cameras and WAPs).
 - a. All installed cabling modular plug terminated links (MPTL) shall comply with the permanent link transmission requirements of the ANSI/TIA-568-2.D standard.

- b. The MPTL shall be tested with a Permanent Link Adapter on the Main Unit and a Patch Cord Adapter Suitable for Category 6A testing on the Far End or Remote Test Equipment.
 - c. Modular plug terminated link test results, including the individual frequency measurements from the tester, shall be recorded in the test instrument upon completion of each test for subsequent uploading for reports to be generated.
5. Sampling is not acceptable. MPTL testing shall be performed on each cabling segment (connector to connector).
- C. Owner reserves the right to hire an independent testing company to spot check the test results. If the results vary more than 10% from the results provided by the Contractor, the Contractor will be required to prove his results are correct or retest the entire system.

5.2 WARRANTY:

- A. Register installation with cable/connectivity manufacturer.
- B. Provide and submit all test results to owner, engineer, and manufacturer and meet all other manufacturer requirements in order to provide minimum 20-year extended product link warranty for complete cabling/connectivity installation, including all copper and optical fiber utilized on the entire channel. The channel warranty shall be provided by the connectivity manufacturer. Include replacement material and installation for any defective product.

5.3 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

5.4 TRAINING:

- A. Provide four hours training on the operation and installation of the structured cabling system at job site, at no cost to owner.

5.5 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 1500

**SECTION 28 3111 – VOICE EVACUATION FIRE ALARM AND DETECTION SYSTEM
PART 1 - GENERAL**

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.
- C. Codes and Standards:
 - 1. NFPA 72; National Fire Alarm and Signaling Code
 - 2. NFPA 3; Recommended Practice for Commissioning of Fire Protection and Life Safety Systems
 - 3. NFPA 4; Standard for Integrated Fire Protection and Life Safety System Testing
 - 4. ASA S3.41; Audible Emergency Evacuation Signal

1.2 DESCRIPTION OF WORK:

- A. Extent of fire alarm and detection systems work is indicated by drawings, schedules and as specified herein. Provide a complete and operating voice evacuation fire alarm system. Provide all conduit and wiring necessary to accomplish the interface to the existing fire command center even though this is not shown on the drawings.
- B. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems that are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories that are FM approved. Comply with State and local requirements as applicable.
- C. Comply with applicable provisions of current NFPA Standards 72, National Fire Alarm Code, local building codes, and meet requirements of local authorities having jurisdiction. The system shall be electrically supervised and monitor the integrity of all conductors.
- D. Carefully review all Division 23 drawings for all fire/smoke dampers. Fire/smoke dampers are NOT shown on electrical plans. Electrical contractor is responsible for coordinating 120V power to all dampers and providing fire alarm connections to each one. See mechanical drawings for all locations. Fire/smoke damper circuiting is per air handler. Provide status of each fire/smoke damper within the fire alarm system.

- E. This section of the specification includes the furnishing, installation, and connection of an intelligent reporting, microprocessor controlled, addressable, fire detection and emergency voice alarm communication system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.
- F. The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.
- G. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event.
- H. The system shall be designed such that each signaling line circuit (SLC) is limited to only 80% of its total capacity at initial installation.
- I. For fans that are not part of the smoke evacuation system, deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed. Selectively activate and/or deactivate fan units as required.
- J. Provide HVAC interface relays per smoke zone for connection into smoke management system. The smoke evacuation system is defined on the Mechanical drawings and specifications. Refer to the mechanical drawings and specifications to ensure correct interface between fire alarm system and smoke control system. Meet with smoke control contractor to ensure no gaps in work are present.
- K. Provide manual fire alarm stations in all rooms with boilers within. Provide external alarm speakers on the outside of every building door.
- L. Provide duct smoke detectors and fan relays at all fan units 2000 CFM and over, provide in supply AND return ducts. Shut down all supply and return fans upon a general alarm signal.

- M. Provide a fire alarm duct detector within 5-feet of any fire/smoke damper as required to comply with IMC 607.5.4.1. The duct detector shall be listed for the air velocity, temperature and humidity at the point where it is to be installed. A duct detector will not be required at a fire/smoke damper located on a corridor wall where the corridor has smoke detection devices installed. For dampers installed within an un-ducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5-feet horizontally of the damper. Provide a fire alarm relay at each fire/smoke damper. Provide a test switch at each location where the damper is located above an inaccessible ceiling or is located more than 10 feet above the finished floor. Coordinate the location of test switches with owner/architect. Refer to mechanical drawings for all fire/smoke dampers—they are NOT shown on the power or systems drawings. Provide 120V on the life-safety branch for their power.
- N. Voice evacuation system is required which meets intelligibility requirements within NFPA 72. Provide manual voice alarm capabilities in elevators and stairways, regardless of what is shown on plans.
- O. Provide waterflow and tamper devices at the lateral connection to EACH sprinkler riser on each floor for each zone. Refer to fire protection drawings for the exact locations of the tamper and flow switches.
- P. Provide voice alarm annunciation in all elevator cabs, regardless of whether shown on plans. Coordinate installation requirements with the elevator manufacturer.
- Q. Interconnect fire alarm system with the access control system so that all exterior doors notify the fire alarm system of a door being opened, coming up as a trouble on the panel.
- R. Provide strobe synchronization by FLOOR, not just strobes that are within view of each other per NFPA—all strobes & speaker/strobes on the same floor shall be synchronized with each other. This requirement is above and beyond the NFPA 72 requirement to ensure the visible signals do not cause a photosensitive epileptic to initiate a seizure.
- S. Provide connection to rolling fire doors located on Level 1 and Level 2, see drawings for exact locations.
- T. Fire alarm loops may not serve more than one floor.

1.3 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. MANUFACTURER: Subject to compliance with requirements, provide fire alarm

and detection systems of one of the following:

1. Gamewell - FCI
- B. The job foreman or lead technician shall be factory trained and certified on the system being installed. Individual shall have a minimum NICET II certification.

2.2 FIRE ALARM AND DETECTION SYSTEMS:

- A. **GENERAL:** Provide an electrically operated, electrically supervised fire alarm system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide a complete operating system. Enclose entire system in raceway. Provide basic wiring materials that comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc. Minimum wire size to be #14 AWG copper.
- B. **SYSTEM TYPE:** Analog addressable, non-coded. Either manual activation of a fire alarm station or activation of an automatic initiating device energizes all fire alarm signaling devices, sounding a non-coded alarm and providing device identification on an annunciator panel.
- C. **SYSTEM OPERATION:** Provide system such that any manual station or automatic initiating device annunciates all alarm indicating units (bells, horns, buzzers, chimes, visual alarm lamps, etc.) continuously until the manual station or initiating device is restored to normal and the fire alarm control unit reset. Annunciate alarm signals by device at the control panel and all remote annunciators. Provide all conductors, raceway, equipment and labor to accomplish the following:
- D. For fans that are not part of the smoke evacuation system, deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed.
- E. Selectively activate and/or deactivate fan units as required.
- F. Release all magnetic door holders upon activation of an alarm from any device by use of a master relay in the control panel.
- G. Provide supervised circuits for the following:
 1. Close dampers upon activation of an alarm from any device through the HVAC interface relays at the Fire Command Center.
 2. Recall elevators, upon activation of an alarm, to the floor of building egress unless the alarm is on the egress floor, in that case recall elevator to the level designated by the Fire Marshall. Cooperate with the elevator

supplier to ensure complete operable system. Provide shunt trip breaker(s) as required.

- H. Central Station Monitoring. Provide a UL listed fire control communicator in accordance with NFPA 71 with a minimum of two reporting zones to the central station. Provide a communicator with dual phone lines for central station reporting by using BFSK or pulsed single round fast format. Provide integral trouble annunciator. Provide with compatibility for automatic test reports every 24 hours. Provide system and components that comply with UL 2635 and UL 864.
- I. Provide fire alarm control panel with capability of shutting down individual initiating devices for maintenance purposes without affecting the continued operation of other initiating devices.
- J. Provide manual fire alarm stations in boiler rooms, and main administrative office. Provide external alarm horns sufficient to be heard in all parking areas.
- K. Sprinkler Supervision. Provide a signal initiating and supervisory circuit to each PIV (post indicator) valve, and to each sprinkler riser and subdivision. Provide continuous alarm signal upon actuation of any water flow signal initiating device. Sound alarm until the condition has been corrected and the panel manually reset as required by UL864. Provide separate alarm zones for: (1) alarm zones from "waterflow alarms", (2) alarm zones from "supervisory alarm" indicating sprinkler system trouble. Provide power to all alarm bells furnished under Division 21 Review final fire sprinkler drawings and coordinate for panel, flow and tamper switch locations.
- L. Provide relays, monitor modules and connections as required at control panel of kitchen hood suppression system for initiation of alarm signal to fire alarm control panel. Connect hood suppression control panel to shunt trip breakers as required.
- M. Provide all required wiring from gas shut off valve to the hood suppression control panel. Make all connections to ensure a properly operating system. Verify with Mechanical Contractor.

2.3 SCOPE OF THE WORK:

- A. Provide al newl fire alarm devices.
- B. Provide duct smoke detectors and fan relays at all fan units 2000 CFM and over. Shut down all supply and return fans upon a general alarm signal.
- C. Provide a fire alarm duct detector within 5-feet of any fire/smoke damper as required to comply with IMC 607.5.4.1. The duct detector shall be listed for the air velocity, temperature and humidity at the point where it is to be installed. A duct detector will not be required at a fire/smoke damper located on a corridor wall where the corridor has smoke detection devices installed. For dampers installed within an un-ducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5-feet horizontally of the damper.

Provide a fire alarm relay at each fire/smoke damper. Provide a test switch at each location where the damper is located above an inaccessible ceiling or is located more than 10 feet above the finished floor. Coordinate the location of test switches with owner/architect.

- D. All initiating devices connected to the fire alarm control panel shall be analog addressable.
- E. All wiring shall be in conduit (3/4" minimum). All conduit and connectors, shall be made of steel. All conduit runs shall form a complete loop from the fire alarm control panel.
- F. Provide vandal resistant cages to protect horn/strobes, smoke and heat detectors as indicated and, in gyms whether shown or not. Securely fasten security cages as required. Provide backing and bracing as required to ensure that attachment extends beyond the ceiling materials. Cages shall have two pieces, one backplate and one cover to attach to backplate.

2.4 FIRE ALARM CONTROL PANEL (EXISTING):

- A. The fire alarm control panel shall be microprocessor-based. Each loop shall be capable of 99 analog addresses and 98 monitor and/or control addresses.
- B. If the microprocessor fails, the system shall execute a default signaling program. This program will enable the panel to sound the audible signals and summon the Fire Department. In addition, a red LED shall light to indicate the device wherein the alarm originated. Inability of the system to sound signals or summon the fire department during microprocessor failure shall not be acceptable.
- C. The fire alarm control panel shall contain a 80 digit alphanumeric display and permit the user to perform all necessary functions including but not limited to the following:
 - 1. Alarm/Trouble Acknowledge
 - 2. Alarm Silence
 - 3. Reset
 - 4. Lamp Test
 - 5. Control of Initiating Devices (on/off)
 - 6. Control of output modules (on/off)
 - 7. Change sensitivity of devices
 - 8. Change time
 - 9. Walk test
 - 10. Check system on battery voltage and current
- D. The fire alarm control panel shall be capable of alarm verification. The control panel shall indicate which smoke detector is in alarm during the pre-alarm

- window.
- E. All alarm signals shall be locked in at the panel until the operated device is returned to it's normal condition and the control panel is manually reset.
 - F. Alarm or trouble activation of initiating points shall be represented in English on the alphanumeric display on both the remote operating panel and the fire alarm control panel indicating the address of the specific device, i.e. Device L4S76, Smoke Detector, 1st floor Rm. 17.
 - G. Each initiating and signal circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring.
 - H. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault condition.
 - I. The system communication loops shall be capable of being wired using Class "A" (Style 6) supervised circuits (a ground fault on either conductor or a break shall not prevent a device from operating on either side of the break)
 - J. The fire alarm control panel shall contain circuitry permitting the transmission of trouble and alarm signals over leased phone lines by the means of reverse polarity. There shall be a supervised disconnect switch to allow testing of the fire alarm control panel without transmitting an alarm to the central station.
 - K. The fire alarm control panel shall include the following features:
 - 1. Auxiliary SPDT alarm actuated contacts.
 - 2. Auxiliary SPDT trouble actuated contacts.
 - 3. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting the normal microprocessor scan and minimize resultant nuisance troubles and/or alarms.
 - 4. A ground fault detector to detect positive or negative grounds on the initiating circuits, signal circuits, power circuits, and telephone line circuit. A ground fault code on the alphanumeric display shall provide indication of either a positive or negative ground fault and shall operate a general trouble but shall not cause an alarm to be sounded
 - 5. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored and shall have a distinctive error message.
 - 6. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.

7. Individual circuit breakers shall be provided for the following: smoke detector power, main power supply, signal circuit #1, signal circuit #2, battery standby power, and auxiliary output.
 8. The fire alarm control panel shall be of dead-front construction. One key shall allow access to all electronics or to the dead-front access to the operator functions
 9. Opening the main door shall expose all components for inspection or adjustment without further dismantling of the cabinet, control unit, or wiring.
 10. It shall be possible to check and adjust the sensitivity of all analog devices from the main fire alarm panel.
- L. The fire alarm control panel shall have batteries capable of powering the system for (24) hours in standby condition and (5) minutes in alarm.
- M. There shall be no special tools required for the programming of devices. A standard slot head screwdriver only.

2.5 REMOTE OPERATING PANEL (EXISTING):

- A. Remote Operating Panel (Provide color as selected by Architect)
- B. The Remote Operating Panel shall contain 80 digit alphanumeric display providing status of all devices including the fire alarm control panel.
- C. The Remote Operating Panel shall permit the user to perform all necessary functions including but not limited to the following:
1. Alarm/Trouble Acknowledge
 2. Alarm Silence
 3. Reset
 4. Lamp Test
 5. Control of Initiating Devices (on/off)
 6. Control of Output Modules (on/off)
 7. Change sensitivity of devices
 8. Change time
 9. Walk test
 10. Check System on battery voltage and current

2.6 MONITOR MODULE:

- A. Remote identification module devices shall be attached to any single normally open initiating device (heat detector, waterflow switch, duct detectors, sprinkler, tamper switches, kitchen hood, pull station, etc.). The modules shall supply addressing and status information to the Fire Alarm Control Panel through the

dual loop module.

2.7 CONTROL POINT MODULE:

- A. The control point module shall be connected to the same loop as the initiating devices, and shall provide a relay output (Form "C" 2 Amp @ 24 VDC, resistive only).
- B. This relay output shall be used to perform auxiliary functions.
- C. When the AOM is activated, the red "ACTIVE" LED shall be on solid. Under normal conditions, the red "ON LINE" LED shall flash.

2.8 DOOR HOLDER (FCI FM-988):

- A. The door holder shall be wall mounted, semi-recessed; be powered at 120 VAC; and have 35 lbs. of holding force and be of a brushed aluminum finish.

2.9 MANUAL FIRE ALARM STATION:

- A. Provide red enclosure, manual fire alarm stations with the following features:
 - 1. Aluminum construction, for flush mounting.
 - 2. Addressable alarm type electrically compatible with system requirements.
 - 3. Double Action
 - 4. Dual-Action design requiring unit to be opened for resetting, and requiring resetting before closing. Key reset, keyed like fire control panel.

2.10 IONIZATION SMOKE DETECTORS:

- A. All ionization smoke detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All ionization fire detectors shall be UL 268 listed. All detectors shall have (2) viewable LEDs to indicate the status of the device.

2.11 PHOTOELECTRIC DETECTORS:

- A. All photoelectric detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All photoelectric detectors shall be UL 268 listed. All detectors shall have (2) viewable LEDs to indicate the status of the device.

2.12 DUCT FIRE DETECTORS (WITH SAMPLING TUBE):

- A. Provide ionization type with UL 268A listings. Each detector shall be equipped

with a remote light. Each detector shall have (2) form "c" alarm contacts rated at 10 amps (at 120VAC).

2.13 THERMAL DETECTORS (FCI ATD WITH/ADB-F BASE):

- A. Thermal detectors shall operate on the Rate-of-Rise principal. The detectors shall have a fixed temperature rating of 135 degrees Fahrenheit. Exception: in Boiler rooms, provide temperature rating of 200 degrees Fahrenheit.
1. The heat detector shall consist of a base and a head.
 2. The base shall be capable of accepting either a smoke detector or a 135 (or 200) degree heat detector.
 3. The head shall automatically restore to its normal standby condition when the temperature returns to its normal range.

2.14 SPEAKERS:

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.
2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust..

2.15 SPEAKER STROBES:

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.
2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.
5. The strobe shall comply with the NFPA 72 requirements for visible signaling appliances, flashing a 1Hz over the strobe's entire operating voltage range.

2.16 STROBES:

- A. Provide strobe with flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and high intensity 110 candela minimum. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer. Furnish in Red/White (color by Architect).

2.17 CEILING MOUNT STROBES (WHEELLOCK RSS24100C-FW, FLUSH MOUNT, WHITE):

- A. Provide strobe UL listed for ceiling mounting, flush mounted in ceiling or concrete vaulted ceiling. Provide strobe with flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and 110 candela minimum.
- B. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer.
- C. Furnish in Red/White (color by Architect).

2.18 HORN FOR ANIMAL HOLDING AREA (ARROWMIGHT SILENTONE ALARM):

- A. Provide horn for animal holding areas as indicated on the drawings.
- B. 97 dB at 450 mm.

2.19 AUXILIARY RELAY:

- A. Remote auxiliary relay boards shall be rated at 10 AMPS @ 120 VAC. A red LED shall light to indicate relay activation. All relays shall transfer on general alarm and latch on until reset. All relays shall be supervised. The control output provided can be used in conjunction with fire alarm applications (i.e. fan controls, dampers, doors, and any other general alarm control).

2.20 INITIATING MODULES:

- A. Provide style "6" initiating modules capable of receiving and annunciating an alarm from any detector, even with a single fault condition on any initiating circuit.
- B. Power all smoke detectors from the "Style 6" initiating loop wiring. For systems that power smoke detectors separately from the "Style 6" loop, provide monitoring for both the power source and the independent initiating wiring, so that complete trouble and alarm indication is achieved by loop. Provide capability to operate all smoke detectors, even with a single fault condition on the smoke detector power wiring. Provide one spare initiating circuit.

2.21 SIGNALING MODULES:

- A. Provide signaling as required. Provide power adequate to sound all signaling devices concurrently. Provide supervised indicating circuits for polarized 24V D.C. alarm signaling devices. Provide 2 spare signaling circuits.
- B. Each signal circuit shall have a separate disconnect switch for servicing the fire alarm system. Each and every indicating circuit shall have a distinct location description. Power supply shall be at fire alarm control panel. Remote power supplies and indicating circuits will not be acceptable.

2.22 SUPPLEMENTAL NOTIFICATION CIRCUITS:

- A. Provide supplementary notification appliance circuit panel(s) as required. The 'SNAC' shall be capable of supplying up to four, Class A, Style Z notification appliance circuits. The panel shall contain its own battery charger, regulated power supply, and shall be supervised for ground fault, overcurrent, open circuits and low battery conditions. Ground fault, battery and circuit trouble conditions shall transmit a trouble signal to the main fire alarm control panel.

2.23 DOOR HOLDER POWER SUPPLY:

- A. Door holders shall be powered by a power supply separate from the fire alarm system power supply. The power supply shall have its own battery back-up capable of holding all doors for a minimum of one hour on the loss of 120vac supply power.

2.24 SYSTEM CONFIGURATION PROGRAMMING:

- A. To help the owner in programming, system changes, and servicing, the fire alarm system shall have the following functions.
 - 1. The FACP shall be capable of an auto-configuration, that via a password, all analog devices and panel modules are automatically programmed into the system. At this point the system will operate as a general alarm system without any other programming.
 - 2. If any two devices are addressed the same, the LED's on both devices will light steady and the panel will read "extra address and the address number".
 - 3. If any device is installed and not programmed into the system the LED will light steady and the panel will read the same as above.

2.25 BATTERIES/POWER SUPPLIES:

- A. Battery:
 - 1. Shall be 12 volt, Gell-Cell type.
 - 2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
 - 3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.
- B. External Battery Charger:
 - 1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/240-volt 50/60 hertz source.

2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

- A. Approved Plans: A copy of the approved and stamped plans shall be on site during the installation and at the time of inspection to verify that the system is installed according to the approved plans.
- B. Install fire alarm and detection systems as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "standard of installation".
- C. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 26 Basic Materials and Methods section, "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings", and in accordance with other sections, as applicable.
- D. All wire used on the fire alarm system shall be U.L. Listed as fire alarm protective signaling circuit cable per NEC, Article 760.
- E. If twisted or shielded wire is required or recommended by the manufacturer it must be used.
- F. Review proper installation procedure for each type of device with equipment supplier before installation.
- G. Provide a minimum of one 3/4" conduit with (2) Cat 5e telephone cables from FACP to main telephone terminal.
- H. Where smoke or heat detectors are specified, install device a minimum of three feet from adjacent air supply diffusers to ensure proper operation of device.
- I. Refer to NFPA for spacing and exact placement of fire alarm devices.
- J. All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate cross talk.
- K. Provide (2) telephone cables from FACP to main equipment room where the incoming telecommunications utility arrives within (1) 1" conduit.
- L. Electrical Identification: Refer to Section 260553 for requirements.

PART 4 - FINAL ACCEPTANCE AND GUARANTEE

4.1 GUARANTEE:

- A. Furnish a three-year guarantee for all equipment, materials and installation, including all labor, transportation, and equipment.
- B. Emergency Response. The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem on a continuous basis.

4.2 PRE-TEST:

- A. The contractor shall with a representative of the manufacturer conduct a test 3 days before the final test to verify operation of all devices. Any problems must be corrected before the final test.

4.3 FINAL TEST:

- A. Before the installation shall be considered completed and acceptable, a test on the system shall be performed as follows:
 - 1. The contractor's job foreman, a representative of the manufacturer, a representative of the owner, shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel. Fan shutdown and door holder circuits shall operate.
 - 2. Conduct a full 24 hour test of battery operation. System shall be put on the batteries for a full 24 hours and all notification appliances shall be operational for a period of 5 minutes.

The supervisory circuitry of the initiating and indicating circuits shall also be verified.

4.4 SPARE PARTS: Refer to Section 26 0502 for requirements.

PART 5 - AS BUILT DRAWINGS AND OPERATION AND MAINTENANCE MANUALS:

5.1 LABELING:

- A. All devices shall be labeled with their appropriate address. The labels shall be 18 point pressure sensitive labels.
- B. All initiating devices shall be programmed to include the device address and a complete user text English location description, i.e. Device L4S76, Smoke Detector, 1st floor Rm.17

5.2 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

5.3 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

5.4 TRAINING:

- A. Provide four (4) hours training on the operation and installation of fire alarm system, at job site, at no cost to owner. Provide programming training and software sub-licensing in owner's name. Sub-licensing agreement shall include the U.L. requirement to allow the owner to do any programming that the supplier is allowed to do during commissioning, testing, service and field additions or deletions to the fire alarm system. The fire alarm supplier shall provide this training and licensing at no cost to the owner, including transportation lodging, meals, and training manuals.

END OF SECTION 28 3111