FRANKENMUTH INSURANCE

EXECUTIVE SUITE RENOVATION
1 MUTUAL AVENUE
FRANKENMUTH, MICHIGAN

Project Manual

IDS Project No. 20120-2000

iDS

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Bids

Project Manual

Frankenmuth Insurance
Executive Suite Renovation
Frankenmuth, Michigan

INTEGRATED design SOLUTIONS
architecture engineering interiors & technology

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IDS Project No. 20120-2000

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Project Information.
2. Work Performed by Owner.
3. Owner-furnished/Contractor-installed (OFCI) products.
4. Owner-furnished/Owner-installed (OFOI) products.
5. Contractor's use of site and premises.
6. Coordination with occupants
7. Work restrictions.
8. Specification and Drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: IDS Project No. 20120-2000, Frankenmuth Insurance, Executive Suite Renovation.

1. Project Location: 1 Mutual Avenue, Frankenmuth, Michigan.

B. Owner: Frankenmuth Insurance, 1 Mutual Avenue, Frankenmuth, Michigan.

C. Architect: Integrated Design Solutions, 1441 West Long Lake Road, Suite 200, Troy, Michigan.

1.4 WORK PERFORMED BY OWNER (If any)

A. 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.

1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS (If any)

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

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

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

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

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

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

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

1. As indicated on Drawings and in Specification Sections.

1.6 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS (If any)

A. The Owner will furnish and install products indicated.

B. Owner-Furnished/Owner-Installed (OFOI) Products: (If any)

1. As indicated on Drawings and in Specification Sections.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

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

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

1. Driveways, Walkways and Entrances: Keep driveways, 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.

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

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.

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

1.8 COORDINATION WITH OCCUPANTS

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

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

1.9 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

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

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated or required by Owner. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: 7:00 a.m. to 7:00 p.m; subject to Owner approval.

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

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

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

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

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

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

1.10 SPECIFICATION AND DRAWING CONVENTIONS

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

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

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

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 3300 - 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:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.
3. Submittal Form.
4. CAD/BIM File Release Form.

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. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
3. 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.

1.5 SUBMITTAL FORMATS

A. Submittals shall be electronic, unless otherwise indicated.

1. Prepare submittals as a single PDF package, incorporating complete information into PDF file.

a. Name PDF file with submittal number.

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

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

C. Options: Identify options requiring selection by Architect.

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

1.6 SUBMITTAL PROCEDURES

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

1. Email: Prepare each submittal as a single PDF package and transmit to Architect, through Construction Manager, by sending via email.

a. Send submittals to the following email address:

1) shop_drawings@ids-michigan.com

b. Subject Line: The Subject line of email should indicate the IDS project number, the project name, and specification section number (In this order).
c. IDS submittal form must be completed and included at the beginning of, and in the same PDF, as the submittal.
d. Submit only one specification section in each e-mail.
e. Architect, through Construction Manager, will return review comments in a PDF file.

2. Web-Based Project Management Software: When used for a Project, prepare submittals in PDF form, and upload to web-based Project management software website instead of using email.

    a. Enter required data in web-based software site to fully identify submittal.
    b. IDS submittal form must be completed and included at the beginning of, and in the same PDF, as the submittal.
    c. Submit only one specification section in each e-mail.

B. Submittal Form:

1. Refer to copy of form at the end of this Section.

    a. Additionally, at construction kick-off meeting the Architect will transmit the Submittal Form to the Contractor in both Word and PDF format.

2. Complete and fill out the following information on the submittal form.

    a. Item (1) – Project Title/Location: Refer to Title Page of specifications. Include Bid Package number, if applicable.
    b. Item (2) – From/Return to: Contractor's/Construction Manager's name and address to whom submittal is to be returned
    c. Item (3) - IDS Project No.: Integrated Design Solutions' project number.
    d. Item (4) - Submittal Date:
    e. Item (5) - Submittal Number: Use 1, 2, 3, etc. for easy reference of each separate submittal.
    f. Item (6) - If this is a Partial Submittal of this item, check the box and use "1.1", "1.2", etc. in the submittal number space. If this is a complete submittal, do not check box.
    g. Item (7) - If this is a resubmittal (revision to a previous submittal), check the box and use the original submittal number and number the submittal "1A", "1B", etc in the submittal number space. If this is a new submittal, do not check box.
    h. Item (8) – Project Manual Section No.: Indicate the Project Manual Specification Section number relating to the submittal
    i. Item (9) – Product Manufacturer: Insert name of product manufacturer.
    j. Item (10) - Item Description (specific information, not just "drawings", i.e. Curtainwall Shop Drawings.
    k. Item (11) – Number of copies. Indicate the number of copies, product data, samples, etc. of each item being submitted.
    l. Item (12) – Contractor's/Construction Manager's Remarks & Deviations (if any): Indicate appropriate remarks and note any deviations from the requirements of the Contract Documents, as required, and sign the certification that all submittals have been reviewed.
    m. Item (13) – Addendum or Bulletin (if any): Indicate if submittal information is based on an addendum or bulletin. Indicate number of issue.
    n. Item (14) – Substitution (if any): Indicate whether the submittal was approved under a separate Substitution

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

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

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

D. 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, through Construction Manager, will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 15 days for review of each resubmittal.
3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.

E. Resubmittals: Make resubmittals in same format as initial submittal.

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

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

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

1.7 SUBMITTAL REQUIREMENTS

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

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

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

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

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

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

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

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

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

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

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

3. Email or Web-Based Transmittal: Provide PDF transmittal. Include digital image illustrating Sample characteristics and identification information for record.

a. In addition to electronic submittal, submit actual physical samples.

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

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

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

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

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

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

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

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

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

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

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

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

1.8 DELEGATED-DESIGN SERVICES

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

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

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

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
2. When requested by Architect, provide three paper copies of certificate, signed and sealed by the responsible design professional

1.9 CONTRACTOR'S REVIEW

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

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

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

1.10 ARCHITECT'S REVIEW

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

1. Email or Web-Based Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

a. No Exceptions Taken: Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
b. Exceptions As Noted: Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
c. Rejected: Do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary, to obtain different action mark.

1) Do not use, or allow others to use, submittals marked "Rejected" at the Project Site or elsewhere where Work is in progress.

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

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

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

E. Architect will return without review submittals received from sources other than Contractor.

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

1.11 CAD/BIM FILE RELEASE FORM

A. Contractor's use of architect's computer-aided drafting (CAD) or building information modeling (BIM) files.

1. At Contractor's written request, copies of Architect's Computer-Aided Drafting (CAD) or Building Information Modeling (BIM) files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

a. Contractor shall submit a fully executed “Request for Integrated Design Solutions, LLC (IDS) from Contractor For Transfer of Computer-Aided Drafting (CAD) or Building Information Modeling (BIM) Files on Electronic Media” form indicating acceptance of the terms and conditions therein.

1) Refer to copy of form at the end of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3300

SUBMITTAL FORM

Project Title (1):	
IDS Project No. (3):	
Submittal Date (4):	

From/Return To (2):

Submittal No.(5):		☐ Partial (6) ☐ Resubmittal (7)	IDS Submittal No.:	

Project Manual Section No. (8):		Manufacturer(s) (9):	

Item Description (10)	Print (11)	Product Data	Sample	Other	☐ A	☐ M	☐ E	☐ EN	☐ S	☐ C	☐ DN	☐ FS	☐ IN	☐ TE

Contractor's/Construction Manager's Remarks and Deviations (12):

Addendum or Bulletin: (13)

Substitution: (14)

The undersigned certifies that the above submitted items have been reviewed in detail, including materials, quantities, dimensions, specified performance criteria, installation requirements, catalog numbers and field conditions and are correct and in strict compliance with the Contract Documents, except as the undersigned has noted otherwise. Approval of items does not relieve the Contractor/Construction Manager from complying with all requirements of the Contract Documents. IDS review does not relieve the contractor from responsibility for errors or omissions in this submittal.

Contractor/Construction Manager: _____

Signature _____

IDS Remarks:

IDS Construction Administration Approval:

_____

Date: _____

ACTION CODES: **IDS Received Stamp**

1. NO EXCEPTIONS TAKEN
2. EXCEPTIONS AS NOTED
3. REJECTED
4. ACTION NOT REQUIRED

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grand rapids, mi 49546

1441 w. long lake road, ste. 200
troy, mi 48098

248-823-2100 www.ids-michigan.com

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architecture engineering interiors & technology

INSTRUCTIONS

A. Use this form for all submittals. Integrated Design Solutions, will furnish the Contractor/Construction Manager with forms.

B. Organize submittals by Specification Section. Use a separate form for submittals of each Specification Section. **DO NOT SUBMIT ITEMS SPECIFIED IN DIFFERENT SPECIFICATION SECTIONS ON ONE SUBMITTAL FORM**.

C. Fill in submittal form as follows:

(1) Project Title and Location. (Refer to Title Page of specifications. Include Bid Package number, if applicable.)

(2) Contractor's/Construction Manager's name and address to whom submittal is to be returned.

(3) Integrated Design Solutions' project number.

(4) Submittal Date.

(5) Submittal Number: Use 1, 2, 3, etc. for easy reference of each separate submittal.

(6) If this is a Partial Submittal of this item, check the box and use "1.1", "1.2", etc. in the submittal number space. If this is a complete submittal, do not check box.

(7) If this is a resubmittal (revision to a previous submittal), check the box and use the original submittal number and number the submittal "1A", "1B", etc in the submittal number space. If this is a new submittal, do not check box.

(8) Indicate the Project Manual Specification Section number relating to the submittal.

(9) Manufacturer: Insert name of product manufacturer, (e.g., Liebert).

(10) Item Description: Insert a brief statement describing the submitted item in generic terms (e.g. Ceramic Mosaic Tile, etc.) with a list of all drawings or identifying numbers.

(11) No. of Copies: Indicate the number of copies, product data, samples, etc. of each item being submitted (e.g. prints-2, reproducible-1, etc.).

(12) Indicate appropriate remarks and note any deviations from the requirements of the Contract Documents, as required, and sign the certification that all submittals have been reviewed.

(13) Indicate if submittal information is based on an addendum or bulletin. Indicate number of issue.

(14) Indicate whether the submittal was approved under a separate Substitution Request.

D. The balance of this form will be filled in by Integrated Design Solutions, and returned to the Contractor along with the submittal.

Request for Integrated Design Solutions, LLC (IDS) from Contractor For Transfer of
Computer-Aided Drafting (CAD) or Building Information Modeling (BIM) Files on Electronic Media

Project Administrator:	_____	Contractors:	_____
IDS Project Number:	_____		_____
Project Name:	_____	Construction Manager:	_____
Location:	_____		_____
Bid Package Number	_____	Date:	_____

IDS is requested to provide the following CAD/BIM files, as listed, for the named project, for the convenience of the contractor in preparing shop fabrication drawings:

Drawing No./BIM File Discipline	Drawing Title	Issue Date of Drawing/BIM File
_____	_____	_____
_____	_____	_____
_____	_____	_____

Drawings were prepared on the following:

Software: _____ Operating System: _____

Check appropriate format for requested files.

DWG _____ DXF _____ IGES _____ NWD _____ RVT _____ DGN _____

TERMS AND CONDITIONS

1. IDS makes no representation as to the compatibility of the CAD/BIM files with any hardware or software.

2. Since the information set forth on the CAD/BIM files can be modified unintentionally or otherwise, IDS reserves the right to remove all indicia of its ownership and/or involvement from each electronic display.

3. Contractor will use figured dimensions only and will not “pull” dimensions from the CAD/BIM files.

4. All information on the CAD/BIM files is considered instruments of service of IDS and shall not be used for other projects, for additions to this project, or completion of this project by others. CAD/BIM files shall remain the property of IDS, and in no case shall the transfer of these files be considered a sale.

5. IDS makes no representation regarding the accuracy, completeness, or permanence of CAD/BIM files, nor for their merchantability or fitness for a particular purpose. Addenda information or revisions made after the date indicated on the CAD/BIM files may not have been incorporated. In the event of a conflict between IDS’ sealed contract drawings and CAD/BIM files, the sealed contract drawings shall govern. It is the Contractor’s responsibility to determine if any conflict exists. The CAD/BIM files shall not be considered to be Contract Documents as defined by the General Conditions of the Contract for Construction.

6. The use of CAD/BIM files prepared by IDS shall not in any way obviate the Contractor’s responsibility for the proper checking and coordination of dimensions, details, member sizes and gage, and quantities of materials as required to facilitate complete and accurate construction of the project.

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7. The Contractor/Construction Manager shall, to the fullest extent permitted by law, indemnify, defend and hold harmless IDS and its subconsultants from all claims, damages, losses, expenses, penalties and liabilities of any kind, including attorney's fees, arising out of or resulting from the use of CAD/BIM files by the Contractor, or by third party recipients of the CAD/BIM files from the Contractor.

8. IDS believes that no licensing or copyright fees are due to others on account of the transfer of the CAD/BIM files, but to the extent any are, the Contractor will pay the appropriate fees and hold IDS harmless from such claims.

9. Any purchase order number provided by the Contractor is for the Contractor's accounting purposes only. Purchase order terms and conditions are void and are not a part of this agreement.

10. This agreement shall be governed by the laws of the State of Michigan.

3D TERMS OF USE

1. The 3D Computer Model(s), including but not limited to related calculation modeling and material, for the Project is provided by IDS as defined above to the User/Recipient as defined above (individually, a "User", or collectively, "Users") at the User's request subject to the terms and conditions stated below (the "Terms of Use"). User hereby acknowledges and agrees to the following terms and conditions.

2. The 3D Model is made available to User solely as a convenience to the User and for informational purposes only. The User is not to rely upon the 3D Computer Model and the data and/or information contained therein in preparing any of its documents for the Project. The User acknowledges that the 3D Computer Model is not a part of the Construction or Contract Documents for the Project and that IDS makes no representations or warranties, expressed or implied, regarding the 3D Computer Model, the accuracy or completeness of the 3D Computer Model or the data and/or information contained therein. It is agreed that the 3D Computer Model is generated for the purposes of assisting in the construction of the Project, the sealed construction drawings/instruments of service ultimately govern the design and the construction of the Project. The construction drawings/instruments of service trump the 3D Computer Model as the ultimate authority for the design and construction of the Project and are the Project's governing documents.

3. The User agrees that these terms apply to the 3D Model in its entirety, together with all of its component parts and data. The User acknowledges that the requirements of these Terms of Use apply to all of User's principals, employees, agents, consultants, and trade contractors, including all subcontractors.

4. The User agrees that the use of the 3D Computer Model is solely at the User's risk and that the User assumes full responsibility and liability in connection with the User's use of the 3D Computer Model and the information and/or data contained therein. The User agrees that IDS has no responsibility for any deficiencies, inaccuracies, errors and/or omissions contained in the 3D Computer Model or the data and/or information contained therein. IDS has no responsibility for any deficiencies or defects in the User's documents, work and/or services resulting from the User's use of the 3D Computer Model in lieu of the Construction and/or Contract Documents for the Project.

5. The User acknowledges and agrees a) that the use of the 3D Computer Model is not a substitute for professional judgment, b) that the use of the 3D Computer Model does not relieve the User from applying the appropriate standard of care and skill relevant to the use of the 3D Computer Model and its contents; c) that the 3D Computer Model is only to be used as a tool to assist the User in connection with the Project; d) that the User is solely responsible for verifying the accuracy of all results created with the use of the 3D Computer Model; and e) IDS is not responsible or liable for the means and methods of construction and the User's use of the 3D Computer Model shall in no way give rise to such duty or liability by IDS or its consultants.

6. IDS AND ITS CONSULTANTS SPECIFICALLY DISCLAIM ALL WARRANTIES WHETHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ALL WARRANTIES OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE, CONSTRUCTABILITY, NON-INFRINGEMENT, COMPATIBILITY, SECURITY OR ACCURACY. USERS' USE OF THE 3D COMPUTER MODEL IS AT ITS OWN RISK. USER ASSUMES FULL RESPONSIBILITY AND RISK OF LOSS RESULTING FROM USE OR INABILITY TO USE THE 3D COMPUTER MODEL OR ITS CONTENT AND WAIVES ANY AND ALL CLAIMS AGAINST IDS IN ANY WAY RELATED TO THE 3D COMPUTER MODEL.

7. The User further agrees that the 3D Computer Model contains information that is confidential and proprietary to IDS, and that IDS retains the ownership and all other reserved rights in the work product reflected in the 3D Computer Model that was prepared by IDS or its consultants for the Project. IDS grants the User a non-exclusive, non-transferable royalty-free license to use the 3D Computer Model for information purposes only in connection with the Project [or defined other specific task] in strict accordance with these Terms of Use. The User agrees that the 3D Computer Model will be used solely and exclusively for the Project and that it will not use the 3D Computer Model and the data and/or information contained therein, in whole or in part, for any purpose or project other than the Project. The User further agrees that the 3D Computer Model will continue to be kept confidential by the User, and that it shall not be disclosed in any manner, transferred or exchanged to any third parties by the User without the expressed, written consent of IDS.

8. Upon completion of the User's involvement with the Project or at any time upon written request of IDS, the User shall upon request promptly deliver to IDS the 3D Computer Model and any other material containing or reflecting any information or data in the 3D Computer Model (whether prepared by IDS, the User or otherwise) and will not retain copies, extracts or other reproductions, tangible or intangible, in whole or in part of the 3D Computer Model. The User's non-disclosure and non-use obligations set forth herein shall survive the return, destruction or deletion of the 3D Computer Model. If the User becomes legally compelled, by subpoena or court order to disclose the 3D Model, or any information contained therein, the User shall provide IDS with prompt notice so that a protective order or other appropriate remedy may be sought by and/or compliance with the provisions of the Terms of Use may be waived.

9. User hereby agrees that IDS shall be entitled to equitable relief, including injunction, in the event of any breach of the Terms of Use, including without limitation its obligations to maintain the confidentiality of the 3D Model, that the granting of such relief will not be opposed and that such relief shall not be the exclusive remedy for such breach. IDS's failure to insist upon strict adherence to any term of these Terms of Use shall not be considered a waiver thereof or deprive IDS of the right subsequently to insist upon strict adherence to that term or any other term of this Terms of Use.

10. The User hereby agrees, to the fullest extent permitted by law, that in no event shall IDS be liable to User for any damages or losses of any kind including, but not limited to, damages by death or bodily injury to persons, injury to property, and direct, indirect, consequential, special, or incidental damages, resulting from any error, omission, inaccuracy, deficiency or defect in or problem with, the 3D Computer Model or the data and/or information contained therein. Without limiting the foregoing, the User acknowledges that the 3D Computer Model and the data and/or information contained therein may be inaccurate and/or incomplete and that IDS will have no obligation to update or modify the 3D Computer Model or any of the data and/or information contained in it because the 3D Computer Model was prepared solely for informational purposes and is not part of the Construction or Contract Documents for the Project.

11. The User its officers, directors, shareholders, partners, agents, employees, consultants, trade contractors, subcontractors or independent contractors shall, to the fullest extent permitted by law, defend, indemnify and hold IDS and its officers, directors, shareholders, partners, principals, consultants, agents and employees harmless from and against any and all actions, damages, demands, claims, suits, losses, liability, judgments, recoveries, costs and expenses including, but not limited to, reasonable attorney's fees related in any way to the 3D Computer model and/or to any use of the 3D Computer Model or the data and/or the information contained therein by the User or any third party who receives the 3D Computer Model from the User. Such claims may include, but are not limited to, any claim which may arise due to deletions, omissions or variations of data due to mechanical or technical failure in connection with the transmission of the 3D Computer Model.

12. The User acknowledges and agrees that it is not in privity of contract with IDS as of result of these Terms of Use with respect to any claims or causes of action related to or arising out of the Project. The User further agrees to obligate any contractor, consultant or other party who uses the 3D Computer Model to be bound in writing by the terms and conditions contained herein and to provide a copy of such acceptance of the Terms of Use to IDS. Any User's use of the 3D Computer Model and the information and/or data contained therein constitutes such User's acceptance of all the terms here specified.

13. The signatory of these Terms of Use on User's behalf warrants to IDS that he/she is duly authorized to sign these Terms of Use on User's behalf and that these Terms of Use are a binding obligation assumed by the User.

14. These Terms of Use shall control and supersede all prior or simultaneous negotiations, representations and agreements, either written or oral including separate agreements between the User and IDS. Signing these Terms of Use indicates the User's agreement to the terms stated above. However in the event that these Terms of Use are not fully executed, they shall nonetheless be effective and controlling to the parties so long as IDS has provided same to the User and it has utilized the 3D Computer Model subsequent to receiving this document without registering its written objections/modifications to these terms.

AUTHORIZED ACCEPTANCE

by Integrated Design Solutions, LLC	by Contractor
Signature	Signature
Print Name and Title	Print Name and Title
Date	Date

Document1

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

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

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

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

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

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

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

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

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

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

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

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

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

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

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.4 DELEGATED DESIGN SERVICES

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

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

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

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

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

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Contractor's quality-control personnel.

B. 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.

C. 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.

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

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

1.8 REPORTS AND DOCUMENTS

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

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

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

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

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

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

1.9 QUALITY ASSURANCE

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

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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

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

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

F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

G. 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.

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

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

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

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

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

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

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

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

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

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

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

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

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

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

D. Testing Agency Responsibilities: Cooperate with Architect, 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 locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."

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

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

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

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

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

1.11 SPECIAL TESTS AND INSPECTIONS

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

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, 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 and Commissioning Authority, 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. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

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

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, Construction Manager's and authorities' having jurisdiction reference during normal working hours.

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

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 - 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 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

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

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

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

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

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

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

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

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

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

1.3 INDUSTRY STANDARDS

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

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

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

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

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

1.4 ABBREVIATIONS AND ACRONYMS

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

B. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. EPA - Environmental Protection Agency; www.epa.gov.
2. OSHA - Occupational Safety & Health Administration; www.osha.gov.
3. USDA - Department of Agriculture; www.usda.gov.

1.5 CODES AND REGULATORY REQUIREMENTS

A. Regulatory requirements applicable to this project: Refer to Drawings.

B. Where Drawings and specification sections reference more current standards or codes, comply with the more restrictive requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 6000 - 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. Section includes administrative and procedural requirements for substitutions.

1.3 DEFINITIONS

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

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

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

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

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

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

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.

2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

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

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

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

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Provide one of the following, or a similar form:

a. CSI Form 1.5C during bidding phase.
b. CSI Form 13.1A after bidding phase.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication, or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

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

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

1.5 QUALITY ASSURANCE

A. Compatibility of 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.

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

C. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.6 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

B. Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 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 that products are undamaged and properly protected.

C. Storage:

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

1.8 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

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

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

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

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

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

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

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

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

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

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

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

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

    a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.

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

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

2.2 COMPARABLE PRODUCTS

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

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

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 3300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

2.3 SUBSTITUTIONS

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

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

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. 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: 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 01 6000

SECTION 01 7300 - 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. Installation of the Work.
2. Cutting and patching.
3. Coordination of Owner's portion of the Work.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.

1.3 DEFINITIONS

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

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

1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

   a. Contractor's superintendent.
   b. Trade supervisor responsible for cutting operations.
   c. Trade supervisor(s) responsible for patching of each type of substrate.
   d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 CLOSEOUT SUBMITTALS

A. Certified statements from existing manufacturers stating that existing warranties have not been affected by cutting and patching work performed under this Section.

1.6 QUALITY ASSURANCE

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

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, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include but are not limited to the following:

   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Plumbing piping systems.
   f. Mechanical systems piping and ducts.
   g. Control systems.
   h. Communication systems.
   i. Fire-detection and -alarm systems.
   j. Conveying systems.
   k. Electrical wiring systems.
   l. 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. Sprayed fire-resistive material.
   e. Equipment supports.
   f. Piping, ductwork, vessels, and equipment.
   g. 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.

1.7 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. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with 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 Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

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

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

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

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

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

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

3.2 PREPARATION

A. Cutting and Patching:

1. Temporary Support: Provide temporary support of Work to be cut.
2. 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.
3. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
4. 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 or prevent interruption to occupied areas.

B. 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.

C. 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.

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

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager

3.3 CUTTING AND PATCHING

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

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

B. 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 in Section 01 1000 "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 or prevent 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 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, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

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

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

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

   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

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

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

3.4 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.

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

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

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

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

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

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

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

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

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

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

1. Comply with Section 01 7700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.5 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
2. Refer to Section 01 1000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.

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 and Owner's separate contractors 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.

3.6 PROGRESS CLEANING

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

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

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

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

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

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

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

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

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

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01.

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

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

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

3.7 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01.

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

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

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

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.8 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

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

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

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

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

END OF SECTION 01 7300

SECTION 01 7700 - 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.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

B. Contractor's List of Incomplete Items (Contractor's "punch list"): Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items (Contractor's "punch list"): Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 SUBSTANTIAL COMPLETION PROCEDURES

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

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

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

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

5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

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

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

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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

1.8 FINAL COMPLETION PROCEDURES

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

1. Submit a final Application for Payment in accordance with Division 01.
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.9 LIST OF INCOMPLETE ITEMS (CONTRACTOR'S "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. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

   a. Project name.
   b. Date.
   c. Page number.

4. Submit list of incomplete items in one of the following formats as directed by Architect:

   a. PDF Electronic File: Architect, through Construction Manager, will return annotated file.
   b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

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

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

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

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

1. Submit on digital media acceptable to Architect or by uploading to web-based project software site.

E. Warranties in Paper Form: In addition to the Warranty Electronic File, provide one copy in paper form.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

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

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

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Remove tools, construction equipment, machinery, and surplus material from Project site.
d. 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.
e. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
f. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
g. Vacuum and mop concrete.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
p. Clean strainers.
q. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste-disposal requirements in Division 01.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 7300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 7700

SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1.3 DEFINITIONS

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

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

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority (if any) will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

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

1. Submit on digital media acceptable to Architect or by uploading to web-based project software site as directed by Architect. Enable reviewer comments on draft submittals.
2. Submit two paper copies. Architect, through Construction Manager, will return one copies.

   a. Paper copies may be omitted with written approval of Architect.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority (if any) 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 Authority (if any) will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority (if any) comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority’s (if any) comments and prior to commencing demonstration and training.

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

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

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

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

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

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

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

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

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

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

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

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager (if any).
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority (if any).
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. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

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

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. 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.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

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

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

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

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

1. Fire.

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

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

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

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

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

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

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

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

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

C. Descriptions: Include the following:

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

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

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

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

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

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

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

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

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

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

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

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

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

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

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

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

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

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

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

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

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

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

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

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

1.11 PRODUCT MAINTENANCE MANUALS

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

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

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

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

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

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

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

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7823

SECTION 01 7839 - 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.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Submit annotated PDF electronic files and one paper copies of Record Drawings, including addenda and Contract modifications

1. Paper copies may be omitted with written approval of Architect.

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

1. Paper copies may be omitted with written approval of Architect.

C. Record Product Data: Submit annotated PDF electronic files and directories and one paper copies 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.

2. Paper copies may be omitted with written approval of Architect.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories and one paper copies of each submittal.

1. Paper copies may be omitted with written approval of Architect.

1.4 RECORD DRAWINGS

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

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

   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross-reference record prints to corresponding photographic documentation.

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

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

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

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

1. Formats: Provide both of the following formats unless otherwise directed by Architect.

   a. Same digital data software program, version, and operating system as for the original Contract Drawings.
   b. Annotated PDF electronic file with comment function enabled.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.

4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

C. in a prominent location.

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

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

1.5 RECORD SPECIFICATIONS

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

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

B. Format: Submit record specifications in the following two formats.

1. Annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Specifications
2. Paper copy.

1.6 RECORD PRODUCT DATA

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

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

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

C. Format:

1. Submit record product data in the following two formats.

   a. Annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data
   b. Paper copy.

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

1.7 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:

1. Submit miscellaneous record submittals in the following two formats.

   a. Annotated PDF electronic file or scanned PDF electronic file(s) of marked-up miscellaneous record submittals
   b. Paper copy.

2. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7839

SECTION 02 4119 – SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Abandonment and removal of existing utilities and utility structures.
4. Salvage of existing items to be reused or recycled.
5. Removed and reinstalled items.

1.3 DEFINITIONS

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

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

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

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

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For demolition firm.

B. Qualification Data: For refrigerant recovery technician.

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

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

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

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

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.

1. Minimum of 5 years of documented experience.

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

1.9 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 may remove items:

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. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

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

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

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

1.10 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. Notify warrantor before proceeding.

1. Coordinate with Owner for list of existing warranties still in effect.

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

1.11 COORDINATION

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

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. Review Project Record Documents of existing construction or other existing conditions.

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.

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

C. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

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

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

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

1. Arrange to shut off utilities with utility companies and Owner.
2. Refer to Divisions 20, 21, 22, 23, 26, 27, and 28 for additional requirements.
3. 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.
4. 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.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01.

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.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 8 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements of Division 01.]

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. 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 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

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

1. Where concrete cannot be cut full depth, cut concrete to a depth of at least 3/4 inch. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

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

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

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

3.7 DISPOSAL OF DEMOLISHED MATERIALS

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.

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 Division 01.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 02 4119

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, and finishes.
2. Steel reinforcement bars and welded-wire reinforcement.
3. Concrete formwork.

1.3 DEFINITIONS

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

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

C. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

D. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete Subcontractor.

2. Review the following:

   a. Vapor-retarder installation.
   b. Steel-reinforcement installation
   c. Anchor rod and anchorage device installation tolerances.
   d. Forms and form-removal limitations.
   e. Construction joints, control joints, isolation joints, and joint-filler strips.
   f. Concrete finishes and finishing.
   g. Cold and hot weather concreting procedures.
   h. Curing procedures.
   i. Concrete repair procedures.
   j. Concrete protection.
   k. Special inspection and testing and inspecting agency procedures for field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product and material.

B. Design Mixtures: For each concrete mixture.

1. Include indication where each mix design will be used.
2. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout:

a. Indicate proposed construction joints required to construct the structure.

1) Location of construction joints is subject to approval of the Architect.

2. Concrete Reinforcement:

a. Include placing drawings that detail fabrication, bending, and placement.
b. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

3. Concrete Formwork:

a. For exposed vertical concrete walls, indicate dimensions and form tie locations.
b. Indicate form liner layout and form line termination details.

D. Samples: Submit 3 samples for each of the following:

1. Vapor Retarder: 4 by 4 inch sample.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing and inspection agency: Include copies of applicable ACI certificates.

B. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories
4. Form materials and form-release agents.
5. Floor and slab treatments.
6. Bonding agents.
7. Vapor retarders.
8. Joint-filler strips.

9. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures.
5. Steel Reinforcement:

E. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

F. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder, showing compliance with ICC AC380.

G. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment; with not less than 5 years of documented experience.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

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

1. Supervisors shall have not less than 5 years of documented experience

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

E. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94 and ACI 301.

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

1. Store reinforcement to avoid contact with earth.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete:

1. Comply with ACI 301 unless modified by requirements in the Contract Documents.

a. Provide construction and movement joints required to construct the structure in accordance with ACI 301.

1) Location of construction joints is subject to approval of the Architect.

2. Concrete Reinforcement shall comply with ACI SP-066.

B. Concrete Formwork:

1. Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

a. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. Exposed Surface Form-Facing Material: Smooth as-cast surface form-facing material.

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified and as follows:

   a. Plywood, metal, or other approved panel materials.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

   1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED FORMWORK MATERIALS

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
   2. Form release agent for form liners shall be acceptable to form liner manufacturer.

C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

D. Filler Plates: Galvanized-steel plates secured to underside of existing concrete floors and metal deck at existing holes to be filled with concrete. Use stainless steel fasteners appropriate for substrates.

   1. Galvanized-Steel Sheet: ASTM A653, G90 coating, structural steel, Grade 33.

      a. Thickness: 0.108 inch (12 gage)

2.4 CONCRETE MATERIALS

A. Source Limitations:

   1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
   2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
   3. Obtain aggregate from single source.
   4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

   1. Portland Cement: ASTM C150, Type I, gray or white.
   2. Fly Ash: ASTM C618, Class C or F.

C. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

   1. Provide Class 4S at exterior flatwork and wet interior flatwork areas.
   2. Maximum Coarse-Aggregate Size: 1 inch nominal, unless otherwise indicated.
   3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Other Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II

C. Water and Water Used to Make Ice: ASTM C94, potable

2.6 STEEL REINFORCEMENT

A. Fabricating Reinforcement

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

B. Reinforcing Bars: ASTM A615, Grade 60, deformed.

C. Steel Bar Mats: ASTM A184, fabricated from ASTM A615, Grade 60, deformed bars, assembled with clips.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.7 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

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

C. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

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

a. Fortifiber Building Systems Group, a Henry Company: Moistop Ultra 15 www.henry.com.

b. Inteplast Group; Barrier-Bac, VB-350: www.barrierbac.com.
c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
d. Poly-America; Husky Yellow Guard 15-mil Vapor Barrier: www.yellowguard.com.
e. Raven Industries, Inc.; VaporBlock Series (VB15): www.ravenfd.com.
f. Stego Industries, LLC; Stego Wrap Vapor Barrier (15 mil): www.stegoindustries.com.
g. W. R. Meadows, Inc; Perminator 15 mil: www.wrmeadows.com.

2.9 LIQUID FLOOR TREATMENTS

A. Concrete Hardener/Densifier (Sealer): Penetrating liquid floor treatment. Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

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

a. Dayton Superior; Densifier J13: www.daytonsuperior.com.
b. The Euclid Chemical Company; Euco Diamond Hard: www.euclidchemical.com.
c. Kaufman Products, Inc; SureHard: www.kaufmanproducts.net.
d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Seal Hard: www.lmcc.com.
e. PROSOCO, Inc; Consolideck LS: www.prosoco.com.
f. W.R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com.

2.10 CURING MATERIALS

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

B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F: Black.
b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
c. Ambient Temperature Above 85 deg F: White.

C. Water: Potable or complying with ASTM C1602/C1602M.

2.11 RELATED MATERIALS

A. Bonding Agents: Provide one or more of the following:

1. Latex Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
2. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

a. Types I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

B. Expansion- and Isolation-Joint-Filler Strips:

1. Size and Configuration: Unless otherwise indicated, 1/2 inch thick by height equal to slab thickness, optionally with removable top section that will form 1/2 inch deep sealant pocket after removal.
2. Materials: Provide products manufactured from one or more of the following:

a. Cellulose fiber, ASTM D1751.

b. PVC (Type IV), ASTM D1752.
c. Semi-rigid, closed-cell polypropylene foam ASTM D8139.

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

a. Oscoda Plastics, Inc; Proflex Vinyl Expansion Joints: www.oscodaplastics.com.
b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com.
c. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from from 1/8 inch and that can be feathered at edges to match adjacent floor elevations. For use at floor slab areas beneath a floor finish covering.

1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested in accordance with ASTM C109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations. For use at exposed floor slab areas that will not have a floor finish covering.

1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.13 CONCRETE MIXTURES, GENERAL

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

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

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

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Total Fly Ash and Pozzolan: 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.14 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings and foundations.

1. Exposure Class: ACI 318 F2.
2. Minimum Compressive Strength: 4000 psi, at 28 days.
3. Maximum w/cm: 0.45.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

B. Class B: Normal-weight concrete used for exterior slabs-on-ground and equipment pads.

1. Exposure Class: ACI 318 F3, C2.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.40.
4. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

C. Class C: Normal-weight concrete used for interior slabs and equipment pads.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 520 lb/cu. yd.
5. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.2 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. For concealed concrete:

a. Surface Finish-1.0: ACI 117 Class D, 1 inch.

2. For exposed concrete, concrete surfaces to receive a rubbed finish, or concrete to be covered with a coating or covering material applied directly to concrete:

a. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.

L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Clean embedded items immediately prior to concrete placement.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.5 INSTALLATION OF STEEL REINFORCEMENT

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

B. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

C. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

D. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

E. Provide concrete coverage in accordance with ACI 318.

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

G. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.

H. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.6 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

a. Continue reinforcement across construction joints unless otherwise indicated.
b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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

1. At Contractor’s option one or more of the following methods may be used:

a. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
b. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

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

1. Do not proceed until unsatisfactory conditions have been corrected.
2. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
3. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

1. Do not place concrete floors and slabs in a checkerboard sequence.

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

3.8 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. At concrete surfaces not exposed to view:

a. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

1) Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
2) Remove projections larger than 1 inch.
3) Tie holes do not require patching.
4) Surface Tolerance: ACI 117 Class D.

2. At concrete surfaces exposed to view, concrete surfaces to receive a rubbed finish, concrete to be covered with a coating or covering material applied directly to concrete:

a. ACI 301 Surface Finish SF-3.0:

1) Patch voids larger than 3/4 inch wide or 1/2 inch deep.
2) Remove projections larger than 1/8 inch.
3) Patch tie holes.
4) Surface Tolerance: ACI 117 Class A.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel or broom finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to all interior slab surfaces, unless otherwise indicated.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

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

B. Equipment Pads and Bases:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Prior to pouring concrete, place and secure anchorage devices.

   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.12 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces:

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

C. Curing Unformed Surfaces:

1. Begin curing immediately after finishing concrete.

a. Interior Concrete Floors: Cure for not less than seven days.

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

1. Moisture Curing:

a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
b. Continuous Sprinkling: Maintain concrete surface continuously wet.
c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.13 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Concrete Hardener/Densifier: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs prior to applying liquid floor treatment.
2. Locations:

a. Unless otherwise indicated, provide at unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs.

3.14 JOINT FILLING

A. Refer to Section 07 9200 - Sealants.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

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

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

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

   a. Limit cut depth to 3/4 inch.
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

   a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
   b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

   a. Finish repaired areas to blend into adjacent concrete.

5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.

6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.

e. Keep patched area continuously moist for at least 72 hours.

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

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

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301,

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Steel-reinforcement placement.
3. Steel-reinforcement welding.
4. Headed bolts and studs.
5. Verification of use of required design mixture.
6. Concrete placement, including conveying and depositing.
7. Curing procedures and maintenance of curing temperature.
8. Verification of concrete strength before removal of shores and forms from beams and slabs.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day
2. Slump: ASTM C143:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231 pressure method, for normal-weight concrete:

a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064:

   a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31:

   a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
   b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39.

   a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
   b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
   c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 10 percent of specified compressive strength.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests:

    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.

       1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ACI 117 and ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.17 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.

5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 3000

SECTION 05 4000 - COLD-FORMED METAL FRAMING

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. Wall and soffit framing.
2. Ceiling joist framing.

1.3 DEFINITIONS

A. CFMF: Cold-formed metal framing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, professional engineer, and testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.
5. Miscellaneous structural clips and accessories.

D. Research Reports:

1. For nonstandard cold-formed steel framing post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket, showing compliance with ICC-ES AC380.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

C. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.

D. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

F. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. ClarkDietrich Building Systems: www.clarkdietrich.com.
2. Jaimes Industries Inc.: www.jaimesind.com.
3. Marino\WARE: www.marinoware.com.
4. MBA Building Supplies, Inc.: www.mbastuds.com.
5. State Building Products; www.statebp.com.
6. The Steel Network, Inc: www.SteelNetwork.com.
7. Steel Stud Solutions, LLC; www.steelstudsolutions.com.
8. Telling Industries; www.buildstrong.com.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Unless otherwise indicated, design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Wall Framing:

1) With Masonry Veneer: Horizontal deflection of 1/720 of the wall height.
2) Without Masonry Veneer: Horizontal deflection of 1/360 of the wall height.

b. Interior Wall Framing

1) Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.

a) Exception: Limit deflection of walls to receive hard tile surfaces to 1/360 of the wall height.

c. Ceiling Joist Framing:

1) Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Upward and downward movement of 3/4 inch, unless otherwise indicated.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H but not less than as required by structural performance requirements.
2. Coating: G60; exception, provide G90 at masonry stud backup.

B. Steel Sheet for Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 33 (230) but not less than as required by structural performance.
2. Coating: G60.

2.4 WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
2. Minimum Flange Width: 1-5/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Minimum Flange Width: 1-1/2 inches.

C. Slotted Deflection Track: Provide galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings.

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Track Depth: Matching steel studs.
3. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
4. Provide at partition heads to structure connections, where indicated on Drawings, and elsewhere as required to accommodate axial deflection.
5. Shall prevent cracking of finishes applied to framing resulting from deflection of structure above

D. At Contractor's option, the following products may be used instead of traditional framing and firestopping:

1. General: Provide components UL-listed for use in head of partitions and joint systems and as indicated on drawings.
2. Slotted Deflection and Firestop Track: Galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings. Includes intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

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

      1) ClarkDietrich Building Systems; BlazeFrame (DSL 2): www.clarkdietrich.com.
      2) Marino\WARE; FAS Track 1000: www.marinoware.com.

3. Firestop Track: Galvanized sheet steel track with intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

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

      1) ClarkDietrich Building Systems; BlazeFrame (DL2): www.clarkdietrich.com.

4. Preformed Top Track Firestop Seal: Pre-formed firestop device field-applied to head of top track that expands when exposed to heat or flames to provide a perimeter joint seal.

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

      1) Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com.

2.5 SOFFIT FRAMING

A. Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
2. Minimum Flange Width: 1-5/8 inches.

2.6 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes or punched with enlarged service holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
2. Minimum Flange Width: 1-5/8 inches.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing and bridging.
3. Web stiffeners.
4. Miscellaneous Clips.
5. Backer plates.
6. And other miscellaneous items required for a complete installation.
7. indicated on Drawings.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts and headless, hooked bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780 or SSPC-Paint 20.

B. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 07 2100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: 24 inches.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

a. Stud Spacing: 16 inches, unless otherwise indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing directly over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads or add additional cold-formed metal studs in the field to ensure alignment.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches, unless otherwise indicated on Shop Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.

a. At Contractor’s option provide the following instead of channel bridging:

1) Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install miscellaneous framing and connections, including supplementary framing, diagonal bracing straps, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches, unless otherwise indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install slotted deflection tracks and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

a. At Contractor's option provide the following instead of channel bridging:

1) Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: 16 inches, unless otherwise indicated on Drawings.

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Combination Bridging: Combination of flat, taut, steel sheet straps, and joist-track solid blocking as indicated on Shop Drawings. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall and ceiling sheathing.
2. Wood blocking and nailers.
3. Miscellaneous panels and sheathing.
4. Plywood backing panels.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

B. Exposed Framing: Framing not concealed by other construction.

C. Timber: Lumber of 5 inches nominal size or greater in least dimension.

D. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NLGA: National Lumber Grades Authority.
2. SPIB: The Southern Pine Inspection Bureau.
3. WCLIB: West Coast Lumber Inspection Bureau.
4. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Post-installed anchors.
4. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 LUMBER PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 SHEATHING AND PANEL PRODUCTS, GENERAL

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

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. Lonza Group: www. wolmanizedwood. com.
2. Hoover Treated Wood Products, Inc.: www. frtw. com.
3. Koppers Performance Chemicals, Inc.: www. koppersperformancechemicals. com.
4. Viance, LLC: www. treatedwood. com.

B. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

   a. Inorganic boron (SBX) is prohibited.

2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

D. Kiln-dry plywood and other wood panels after treatment to maximum moisture content of 15 percent.

E. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

F. Identify fire-retardant-treated plywood and panels with appropriate classification marking of qualified testing agency.

1. For exposed plywood and other wood panels indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

G. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

a. At Contractor's option, roof nailers may be non-preservative treated.

2. Plywood and other wood paneling in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing
3. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
4. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
5. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
6. Wood floor plates that are installed over concrete slabs-on-grade.
7. Other items as indicated on Drawings.

2.4 FIRE-RETARDANT-TREATED MATERIALS

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. Lonza Group: www. wolmanizedwood. com.
2. Hoover Treated Wood Products, Inc.: www. frtw. com.
3. Koppers Performance Chemicals, Inc.: www. koppersperformancechemicals. com.
4. Viance, LLC: www. treatedwood. com.

B. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

C. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

D. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

E. Identify fire-retardant-treated lumber with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

F. Identify fire-retardant-treated plywood and other wood panels with appropriate classification marking of qualified testing agency.

1. For exposed plywood and other wood paneling indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

G. Application: Treat items indicated on Drawings, and the following:

1. All interior rough carpentry items unless otherwise indicated.
2. Other items as indicated on Drawings.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Miscellaneous Framing, Blocking, Furring and Nailers

B. Dimension Lumber Items:

1. Species: Provide one of the following:

a. Southern pine or mixed southern pine; SPIB.
b. Spruce-pine-fir; NLGA.
c. Hem-fir; WCLIB, or WWPA

2. Grade: No. 2 or as follows:

a. Standard Grade, provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.6 WALL AND CEILING SHEATHING

A. Plywood Sheathing: DOC PS 1, Exposure 1, Structural I sheathing, Grade C-D.

1. Span Rating: Not less than 48/24.
2. Nominal Thickness: 3/4 inch unless otherwise indicated on Drawings.
3. Tongue-and-groove edges.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.8 MISCELLANEOUS PANELS AND SHEATHING

A. Plywood Concealed from View and Part of Exterior Enclosure: DOC PS 1, Exposure 1, Grade C-D

B. Concealed Plywood at Interior Locations: DOC PS 1, Exposure 2, Grade C-D.

2.9 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.

1. Interior Locations: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
2. Exterior and high relative Humidity Locations: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.10 MISCELLANEOUS MATERIALS

A. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498 and approved for use indicated by adhesive manufacturer

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

a. Franklin International, Inc; Titebond GREENchoice Heavy Duty Construction Adhesive: www. titebond. com.
b. Liquid Nails, a brand of PPG Industries, Inc.; LN-903 Heavy Duty Construction Adhesive (Low VOC): www. liquidnails. com.

B. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:

1. ASTM D226/D226M: Type I.

PART 3 - EXECUTION

3.1 LUMBER INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use copper naphthenate for items not continuously protected from liquid water.

I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous organic felt separator between wood and metal decking.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.2 PANEL AND SHEATHING INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

F. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.3 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.4 WOOD PANEL AND SHEATHING INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Ceiling Sheathing:

a. Nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 06 1000

SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

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 standing and running trim.
2. Interior frames and jambs.
3. Wood paneling.
4. Acoustical wood ceiling.
5. Cabinets and millwork.

    a. Plastic laminate clad cabinets and millwork.
    b. Wood cabinets and millwork.

6. Prefabricated vanity cabinets with integrated sinks and countertops.
7. Countertops.

    a. Solid surfacing countertops.

8. Miscellaneous items:

    a. Other items as indicated on Drawings.

9. Shop finishing of interior architectural woodwork.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.
4. Wood-Preservative Treatment:

    a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
    b. Indicate type of preservative used and net amount of preservative retained.
    c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

5. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
6. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories

1. Include the following:

a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in architectural woodwork

C. Samples for Initial Selection:

1. Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips

D. Samples or Verification: For each exposed product and for each shop-applied color and finish specified. Provide three samples of each of the following:

1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish.
2. Solid Surfacing: 4 by 4 inches, for each type, color, pattern, and finish.
3. Wood Veneer Panel Products: 12 by 12 inches sample for each species, cut, and finish.
4. Lumber for Transparent Finish: 4 by 12 inches for each species, cut, and finish; finish on one side and one edge.
5. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Evaluation Reports: For preservative-treated and fire-retardant-treated wood materials, from ICC-ES.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience

B. Single Source Responsibility: Provide and install interior architectural woodwork from single fabricator.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical interior architectural woodwork as shown on Drawings.

a. Coordinate with Architect to determine the specific mock-ups required.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Frames: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

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.

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents may contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

B. Wood Moisture Content: Comply with requirements of the Architectural Woodwork Standards for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas and as follows:

1. Wood Moisture Content: 5 to 10 percent.

2.3 WOOD MATERIALS

A. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

1. Made with adhesive containing no urea formaldehyde.

B. Softwood Plywood: DOC PS 1.

1. Made with adhesive containing no urea formaldehyde.

C. Particleboard (Medium Density): ANSI A208.1, Grade M-2.

D. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.

1. Made with binder containing no urea formaldehyde.

E. Hardboard: AHA A135.4.

2.4 PRESERVATIVE-TREATED-WOOD MATERIALS

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. Lonza Group: www.wolmanizedwood.com.
2. Hoover Treated Wood Products, Inc.: www.frtw.com.
3. Koppers Performance Chemicals, Inc.: www.koppersperformancechemicals.com.
4. Viance, LLC: www.treatedwood.com.

B. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

C. Extent of Preservative-Treated Wood Materials: Treat interior architectural woodwork in contact with concrete or masonry.

2.5 FIRE-RETARDANT-TREATED WOOD MATERIALS

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. Lonza Group: www.wolmanizedwood.com.
2. Hoover Treated Wood Products, Inc.: www.frtw.com.
3. Koppers Performance Chemicals, Inc.: www.koppersperformancechemicals.com.
4. Viance, LLC: www.treatedwood.com.

B. Fire-Retardant-Treated Wood Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of the Architectural Woodwork Standards. 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.

C. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, 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 (3.2 m) 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.
2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.

D. 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 according to ASTM E84.

1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2, except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.

E. Fire-Retardant Fiberboard: Medium-density 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 according to ASTM E84.

2.6 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as indicated or recommended for specific applications.

1. Manufacturers: Subject to compliance with requirements, provide products as indicated in Color Codes on Drawings.
2. Colors, Patterns, and Finishes: As indicated in Color Codes on Drawings

a. For semiexposed Grade CLS laminate: Color to be white.

B. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness. Match adjacent laminate in color, pattern, and finish.

1. 0.118 inch (3 mm) thick at doors, drawer fronts and countertops.
2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves and interior panels.

2.7 SOLID SURFACING

A. Provide solid surfacing sheet or natural quartz and resin composite sheets as indicated on Room Finish Schedule on Drawings.

B. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous and non-porous; no surface coating; color and pattern consistent throughout thickness.

1. Manufacturers: Subject to compliance with requirements, provide products as indicated in Color Codes on Drawings.
2. Colors, Patterns, and Finishes: As indicated in Color Codes on Drawings

C. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.

1. Manufacturers: Subject to compliance with requirements, provide products as indicated in Color Codes on Drawings.
2. Colors, Patterns, and Finishes: As indicated in Color Codes on Drawings

2.8 MISCELLANEOUS MATERIALS

A. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.

1. Unframed Glass Doors: Seam exposed edges seamed before tempering.

B. Support Faming, Grounds, and Concealed Blocking: Comply with Section 06 1000 - Rough Carpentry.

C. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

E. Solid Surfacing Joint Adhesive: Manufacturer’s standard one or two-part adhesive for inconspicuous, non-porous joints.

F. Adhesive for Bonding Plastic Laminate: Product recommended by fabricator for application.

1. Adhesive for Bonding Edges (edgebanding): Hot-melt adhesive.

G. Installation Adhesives: Products recommended by fabricator for each substrate for secure anchorage.

2.9 CABINET HARDWARE AND OTHER ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Cabinet Hardware, General: BHMA A156.9, types as indicated for quality grade specified.

1. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finish:

a. Satin Nickel.

2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

C. Hinges: Semiconcealed type. Grade 1, 3 knuckle, semi-concealed, institutional hinges, with 3-way adjustment, 270 degree opening, steel with satin finish.

1. Provide two hinges for doors less than 36 inches high and provide three hinges for doors more than 36 inches high.
2. Provide four hinges for tall cabinet doors.
3. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Grass America Inc; Institutional Hinges: www.grassusa.com.
b. Hafele America Co.; Aximat 300 Hinge: www.hafele.com.

D. Slides for Sliding Glass Doors: ANSI/BHMA A156.9, B07063; aluminum.

E. Drawer Slides:

1. General:

a. Grade 1: Self-closing, side mounted and extending under bottom edge of drawer.

1) Type: Full extension.
2) Material: Zinc-plated steel with polymer rollers.

b. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

2. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
3. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1, HD-100.
4. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1, HD-200.

F. Back-Mounted Pulls: Back mounted, solid metal, wire pulls, 5 inches wide, center-to-center.

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

a. Richelieu; Traditional Metal Pull 7759: www.richelieu.com

G. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.

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

a. Hafele America Co.; Model 246.26.702: www.hafele.com.
b. Stanley; SP46

H. Elbow Catches for Inactive Leaf of Pairs of Doors: ANSI/BHMA A156.9, B33023.

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

a. Ives No. 2: www.iveshinges.com.

I. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

J. Shelf Rests - Pin Type: ANSI/BHMA A156.9, B04013; metal. Standard side-mounted system using multiple drilled holes in cabinet sides for pin supported shelf rests, satin chrome finish, for nominal 1 inch spacing adjustments

K. Grommets for Cable Passage: 2-inch OD, unless otherwise indicated, molded-plastic grommets and matching plastic caps with slot for wire passage.

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

a. Doug Mockett & Company Inc.; TG Series: www.mockett.com.

L. Coat Rod and Brackets:

1. Rod:

a. Material: Steel Tubing.
b. Outside Diameter: 1-5/16 inches.
c. Wall Thickness: 0.106 inches.
d. Length: As indicated.

2. Brackets: Wall flanges; steel.
3. Finish: Chrome.
4. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Knape & Vogt; KV 770 Series Rod with 764 Wall Flanges: www.knapeandvogt.com.

M. Countertop Support Brackets:

1. Exposed Tee-Shaped Brackets: Fabricated from 6063-T6 extruded aluminum 2 inches by 3 inches by 3/16 inch Tee.

a. Finish: Black.
b. Size: 18 inch support unless otherwise indicated.
c. Maximum Weight: 450lbs per bracket.
d. Products: Subject to compliance with requirements, provide one of the following:

1) Rakks Model EH 1818; Rangine Corp.: www.rakks.com.
2) HYB(1.5)18; A&M Hardware, Inc.; www.aandmhardware.com.

2. Concealed Flush Mount (Inside Wall Mounted) Brackets: Fabricated from 6063-T6 extruded aluminum 2 inches by 3 inches by 3/16 inch; Tee-shape horizontal and L-shape (concealed) vertical.

a. Finish: Black.
b. Size: 18 inch support unless otherwise indicated.
c. Maximum Weight: 450lbs per bracket.

d. Locations: Provide where concealed flush mount is indicated on Drawings.
e. Products: Subject to compliance with requirements, provide one of the following:

1) Rakks Model EH1818-FM; Rangine Corp.: www.rakks.com.
2) C(2.0)18; A&M Hardware, Inc.; www.aandmhardware.com.

N. Press Fit Fasteners: Plastic concealed fasteners for securing panels to frame.

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

a. Hafele America Co.; Keku Press Fit Fasteners No. 262.50.313: www.hafele.com.

O. Backsplash Mounting Hardware: Plastic concealed mounting clips designed to eliminate scribing, mastics, metals and front calking.

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

a. University Plastics, Inc.; TJClip/Smart Clip.

P. Mounting Hardware:

1. Z-Clips: 6063-T6 extruded aluminum z clips. Sized as required to support applied loads. Minimum 3/8 inch lift-off height.

a. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1) Monarch Metal Fabrication: www.monarchmetal.com.
2) Eagle Mouldings Inc.: www.eagle-aluminum.com.

2.10 PREFABRICATED VANITY CABINETS

A. Prefabricated Vanity Cabinets:

1. Factory fabricated cabinets with moisture resistant finishes.

a. Pulls and Knobs: As standard with manufacturer.
b. Drawer Hardware: Undermount, full extension, slow-close type.
c. Hinges: 3-way adjustable, slow close, hinges with 100 degree opening.

2. Finish: Equal to Kohler; F69 Woodland.
3. Products: Subject to compliance with requirements provide the following:

a. Vanity 01: Kohler; Tresham Vanity K-5288: www.kohler.com.

1) Substitutions not permitted.

b. Vanity 02: Kohler; Tresham Vanity K-5289: www.kohler.com.

1) Substitutions not permitted.

B. Integrated Sinks and Countertops

1. Factory fabricated countertop with integrated sink.

a. Material: Vitreous china.

b. Rectangular Basin Size: 18 inches Long by 13 inches Wide by 5-1/2 inches Deep.
c. Includes:

1) 1-3/8 inch faucet hole, 1-3/4 inch drain hole, and overflow drain.
2) Raised outer edge to contain water.

2. Finish: Equal to Kohler; G81 White Impressions.
3. Products: Subject to compliance with requirements provide the following:

a. Vanity 01: Kohler; Ceramic Impressions Vanity Top Bathroom Sink K-2781-1: www.kohler.com. Pairs with Vanity 01.

1) Substitutions not permitted.

b. Vanity 02: Kohler; Ceramic Impressions Vanity Top Bathroom Sink K-2779-1: www.kohler.com. Pairs with Vanity 02.

1) Substitutions not permitted.

2.11 FABRICATION, GENERAL

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.

1. Locate openings accurately and use templates to produce accurately sized and shaped openings

E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with material of same finish and pattern, unless otherwise indicated.

F. Standing and Running Trim:

1. For items other than base wider than available lumber, use veneered construction. Do not glue for width.

G. Interior Frames and Jambs:

1. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.

H. Cabinets and Millwork:

1. Assembly: Shop assemble cabinets and millwork for delivery to site in units easily handled and to permit passage through building openings.
2. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

I. Countertops:

1. Fabricate tops in one piece, unless size dictates multiple pieces.
2. Solid-Surface Sinks: Provide undermount sinks integrated at factory with solid surface countertops.

2.12 INTERIOR STANDING AND RUNNING TRIM

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 6 –Millwork

B. Hardwood Lumber for Transparent Finishes:

1. Species: Select Cherry.
2. Cut: Plain sliced/plain sawn.
3. Wood Moisture Content: 5 to 10 percent.
4. Veneer Grade: AA.

C. Wood Profiles: As indicated on Drawings.

1. Includes, but is not limited to, the following:

a. Wood Base – B-01.
b. Wood Base – B-02.

2.13 INTERIOR FRAMES AND JAMBS

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 6 –Millwork

B. Hardwood Lumber for Transparent Finishes:

1. Species: Select Cherry.
2. Cut: Plain sliced/plain sawn.
3. Wood Moisture Content: 5 to 10 percent.
4. Veneer Grade: AA.

C. Wood Profiles: As indicated on Drawings

1. Door Stops: Ploughed in unless otherwise indicated on Drawings.
2. Glazing Stops: Applied unless otherwise indicated on Drawings.

D. Non-rated Frames: Fabricate from solid wood.

E. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant MDF with veneered exposed surfaces and 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.

1. Fire Rating: As indicated on Drawings.
2. Smoke and draft control door frames shall be tested in accordance with UL 1784

F. Factory machine frames for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions

2.14 WOOD PANELING

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 8 – Wall/Ceiling Surfacing and Partitions.

B. Performance Requirements:

1. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer and fire-retardant cores. Panels shall have flame-spread index of 25 or less and smoke-developed index of 450 or less per ASTM E 84.

C. For Transparent Finishes:

1. Hardwood Lumber:

a. Species: Select Cherry.
b. Cut: Plain sliced/plain sawn.
c. Wood Moisture Content: 5 to 10 percent.

2. Wood Veneer:

a. Species: Select Cherry.
b. Cut: Plain sliced/plain sawn.
c. Wood Moisture Content: 5 to 10.
d. Veneer Grade: AA.

3. Veneer Matching:

a. Grain Direction: Vertical.
b. Matching of Veneer Leaves: Slip match.
c. Veneer Matching within Panel Face: Center-balance match.
d. Matching Between Adjacent Panels: Running match.
e. Matching Between Vertical Panels: Continuous match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
f. Blueprint Match – WD-02: Provide blueprint-matched panels and components with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match within wood paneling.

D. Panel Construction: Simulated style and rail.

1. Design: Flat panels with surface applied hardwood running trim.
2. Running Trim Profiles: As indicated on Drawings.
3. Panel Base Thickness: 3/4 inch.
4. Panel Sizes: As indicated on Drawings.
5. Face: Wood veneer.
6. Core: Particle board or medium density fiberboard (MDF); fire-retardant.

7. Panel Edges: Solid hardwood matching wood veneer panel face.

2.15 ACOUSTICAL WOOD CEILING

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 8 – Wall/Ceiling Surfacing and Partitions.

B. Performance Requirements:

1. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer and fire-retardant cores. Panels shall have flame-spread index of 25 or less and smoke-developed index of 450 or less per ASTM E 84.

C. For Transparent Finishes:

1. Hardwood Lumber:

a. Species: Select Cherry.
b. Cut: Plain sliced/plain sawn.
c. Wood Moisture Content: 5 to 10 percent.

2. Wood Veneer:

a. Species: Select Cherry.
b. Cut: Plain sliced/plain sawn.
c. Wood Moisture Content: 5 to 10.
d. Veneer Grade: AA.

3. Veneer Matching:

a. Grain Direction: Vertical.
b. Matching of Veneer Leaves: Slip match.
c. Veneer Matching within Panel Face: Center-balance match.
d. Matching Between Adjacent Panels: Running match.
e. Matching Between Vertical Panels: Continuous match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.

D. Panel Construction: Simulated style and rail.

1. Design: Flat perforated wood panels with acoustic scrim backer.
2. Panel Thickness: 3/4 inch.
3. Panel Sizes: As indicated on Drawings.
4. Face: Wood veneer.
5. Core: Particle board or medium density fiberboard (MDF); fire-retardant.
6. Panel Edges: Solid hardwood matching wood veneer panel face.
7. Perforated wood Ceiling Panels: Provide 1/16 inch diameter holes at 0.175 inch diagonal centers, with 1-1/2 inch solid borders.
8. Scrim: Provide 0.2 mm thick non-woven acoustical liner, sized to fit back surface of panel, and as follows:

a. Flammability: Class A with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
b. Color: Black.
c. Bond liner to back side of perforated wood panel with manufacturer's standard adhesive.

1) Adhesive shall have a VOC content of 50 g/L or less.

2.16 WOOD CABINETS AND MILLWORK

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 10 - Casework and Section 6 - Millwork.

B. Casework Construction Type: Frameless.

C. Door and Drawer Style: Flush Overlay.

D. Exposed Surfaces:

1. Species: Select Cherry.
2. Cut: Plain sliced/plain sawn.
3. Veneer Grade: AA.
4. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
5. Matching of Veneer Leaves: Book match.
6. Veneer Matching within Panel Face: Running match.
7. Matching Between Adjacent Panels: Well matched for color and grain.

E. Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surface.
2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, same species indicated for exposed surfaces
3. Drawer Bottoms: Hardwood veneer plywood.

F. Concealed Surfaces:

1. Manufacturer's choice.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Drawer Construction Method: Multiple dovetailed.

H. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

2.17 PLASTIC LAMINATE CABINETS AND MILLWORK

A. Architectural Woodwork Standards Grade: Premium.

1. Comply with AWS Section 10 - Casework and Section 6 - Millwork.

B. Casework Construction Type: Frameless.

C. Door and Drawer Style: Flush Overlay.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

E. Exposed Surfaces:

1. Horizontal Surfaces: Grade HGL (0.039 inch thick).
2. Vertical Surfaces: Grade VGS (0.028 inch thick).
3. Door and Drawer Edges: PVC edge banding, 0.118 inch (3mm) thick, matching laminate in color, pattern, and finish.

4. Other Edges: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

F. Semi-exposed Surfaces:

1. For semiexposed backs of panels with exposed surfaces: Grade VGS (0.028 inch thick).
2. Surfaces Other Than Drawer Bodies: Grade CLS (0.020 inch thick).

a. Edges of Laminate Shelves: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish.

3. Surfaces of Drawer Subfronts, Backs, and Sides: Grade CLS (0.020 inch thick).
4. Cores of Drawer Subfronts, Backs, and Sides: Hardwood veneer plywood.
5. Drawer Bottoms: Hardwood veneer plywood.

G. Concealed Backs of Panels with Exposed or Semi-exposed Surfaces: Grade BKL (0.020 inch thick).

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Drawer Construction Method: Multiple dovetailed or doweled.

I. All cabinets and millwork shall be fabricated with balance construction.

J. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

1. Includes, but is not limited to, the following:

a. Plastic laminate base – B-04.

2.18 COUNTERTOPS

A. Quality Standard: Premium Grade, in accordance with AWS, unless noted otherwise.

1. Comply with AWS Section 11 – Countertops.

B. Subtops: plywood.

1. Thickness: 3/4 inch.
2. Provide preservative treatment for subtops at sink or other wet locations.

C. Solid Surface Countertops: Solid surfacing over continuous substrate.

1. Flat Sheet Thickness: 1/2 inch, minimum.
2. Substrate: Particle board, medium density fiberboard (MDF) or plywood.

a. Thickness: 3/4 inch.
b. Provide preservative treatment for subtops at sink or other wet locations.

3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

a. Field applied.

6. Fabricate in accordance with manufacturer's standard requirements.

D. Solid Surface Countertops - Natural Quartz and Resin Composite: Sheet or slab of natural quartz and plastic resin over continuous substrate.

1. Flat Sheet Thickness: 3/4 inch, minimum.
2. Substrate: Particle board, medium density fiberboard (MDF) or plywood.

a. Thickness: 3/4 inch.
b. Provide preservative treatment for subtops at sink or other wet locations.

3. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA (DSDM).
4. Other Components Thickness: 3/4 inch, minimum.
5. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
6. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

a. Field Applied.

7. Fabricate in accordance with manufacturer's standard requirements.

2.19 MISCELLANEOUS ITEMS

A. Quality Standard: Premium Grade, in accordance with AWS, unless noted otherwise.

2.20 SHOP FINISHING

A. Quality Standard: Comply with AWS Section 5 – Finishing.

1. Grade: Provide finishes of same grades as items to be finished.

B. General: The entire finish of interior architectural woodwork is specified in this Section, whether shop applied or applied after installation.

1. Shop Finishing: To the greatest extent possible, finish architectural woodwork at the fabrication shop. Defer only final touch up, cleaning, and polishing until after installation.

a. Where field finishing is required, shop apply at least the prime/base coat to the greatest extent possible before delivery.

C. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

D. Transparent Finish:

1. Provide one of the following AWS finishes:

a. Finish: System - 5, Varnish, Conversion.
b. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
c. Finish: System - 10, UV Curable, Water Based.
d. Finish: System - 12, Polyurethane, Water Based.

2. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
3. Staining: Match Architect's samples.

4. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

F. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

G. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

H. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

I. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 96 inches (2400 mm) long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

J. Interior Frames and Jambs:

1. Install door frames and borrowed lite frames level, plumb, true, and aligned with adjacent materials.
2. Install fire-rated frames in accordance with NFPA 80 requirements.
3. Install smoke and draft control door frames in accordance with NFPA 105 requirements.

K. Wood Paneling:

1. Install paneling level, plumb, true in line, and without distortion. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
2. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/16 inch.
3. Anchor paneling to supporting substrates.

L. Acoustical Wood Ceiling:

1. Install paneling level, plumb, true in line, and without distortion. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
2. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/16 inch.
3. Anchor paneling to supporting substrates.

M. Cabinets and Millwork:

1. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

   a. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   b. 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.
   c. Maintain veneer sequence matching of cabinets with transparent finish.
   d. Fasten cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

N. Countertops:

1. General:

   a. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
   b. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

      1) Seal edges of cutouts in plastic laminate countertops and solid surfacing subtops by saturating with varnish.

   c. Apply sealant to gaps at walls with mildew-resistant silicone sealant; comply with Section 07 9200 "Joint Sealants."

2. Solid surfacing countertops:

   a. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

b. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

c. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1) Install metal splines in kerfs in countertop edges at joints where recommended by manufacturer or installer. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.

2) Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned, and joints are of specified width.

d. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

3.3 PREFABRICATED VANITY CABINETS

A. Prefabricated Vanity Cabinets: Install in accordance with manufacturer’s instructions.

B. Integrated Sinks and Countertops: Install in accordance with manufacturer’s instructions.

3.4 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.5 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 06 4023

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Blanket insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, with not less than 5 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Flame-Spread Index: Not more than 0 when tested in accordance with ASTM E84.
2. Smoke-Developed Index: Not more than 0 when tested in accordance with ASTM E84.

3. Density: 2.5 pcf, minimum.
4. Thermal Resistance: R-value of 3.7 per inch.

    a. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

5. Thickness: As indicated on Drawings.
6. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.
    b. Rockwool; Comfortbatt: www.rockwool.com.
    c. Thermafiber Inc., an Owens Corning Company; UltraBatt: www.owenscorning.com.

7. Locations: Metal studs and miscellaneous locations.

2.2 INSULATION FASTENERS

A. Metal Straps and Retainers: As standard with insulation manufacturer; non-corrosive.

2.3 ACCESSORIES

A. Wire Mesh: Galvanized steel, hexagonal wire mesh.

B. Foam Sealant: Single-component spray polyurethane insulating foam sealant.

1. Gun-applied.
2. Expands to fill gaps up to 3 inches.
3. Closed Cell Content: 60 percent, minimum; ASTM D2856.
4. Flammability: ASTM E84.

    a. Flame-spread Index: 25, maximum.
    b. Smoke-developed Index: 450, maximum.

5. Thermal Resistance (R) Value: 4 per inch; ASTM C518.
6. Product: Subject to compliance with requirements, provide one of the following:

    a. Dow Building Solutions, Dow Chemical Company/DuPont; GreatStuff Pro Gaps & Cracks Sealant: www.dow.com.
    b. Owens Corning Corporation; ProPink ComfortSeal Gun Foam: www.owenscorning.com.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For metal-framed wall cavities where cavity heights exceed 96 inches support unfaced blankets mechanically.
4. For wood-framed construction, install blankets according to ASTM C1320.

3.4 INSULATION AT MISCELLANEOUS VOIDS

A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using one or more of the following materials:

1. Mineral-wool blanket insulation.
2. Foam sealant.

B. Install insulation to neatly fit spaces; fill voids completely without compressing insulation.

3.5 FIELD QUALITY CONTROL

A. Do not cover installed insulation until inspections have been completed.

B. Deficiencies shall be corrected by the Contractor at no additional cost to the Owner.

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

SECTION 07 8413 - FIRESTOPPING

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. Firestopping of penetrations.
2. Firestopping of joints.

B. Section includes firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on Drawings or not, and other openings, joints, and construction indicated.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration and joint 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 firestopping system, submit illustration, with modifications marked, approved by firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

a. Obtain approval of authorities having jurisdiction prior to submittal.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

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

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section; with not less than five years of documented experience.

B. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements"; with minimum five years of documented experience.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of each type of penetration and joint firestopping system.

a. Where one design may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination
b. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration and joint firestopping systems when ambient or substrate temperatures are outside limits permitted by firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration and joint firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.10 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.

C. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

D. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration and joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Penetration Firestopping Systems" Article and "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

   a. Penetration and 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."
      3) FM Approval in its "Approval Guide."

2.2 MANUFACTURERS

A. Firestopping Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. 3M Fire Protection Systems; www.3m.com.
2. A/D Fire Protection Systems; www.adfire.com.
3. Hilti Firestop; www.hilti.com.
4. RectorSeal Firestop; www.rectorseal.com.
5. Specified Technologies, Inc. (STI); www.stifirestop.com.
6. Tremco Fire Protection Systems; www.tremcofirestop.com.

2.3 FIRESTOPPING SYSTEMS - GENERAL

A. Provide firestopping assemblies indicated, or, if not indicated, as required to comply with fire ratings indicated.

B. Fire Ratings: As indicated on Drawings.

C. Joint Firestopping:

1. Nominal Widths: As indicated on Drawings.
2. Movement Capabilities: Class 1, 50 percent compression or extension, unless otherwise indicated or required.

2.4 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.

B. Penetrations in Fire-Resistance-Rated Walls and Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 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

   a. At least one hour at horizontal assemblies.

2. Where indicated or required, provide the following:

   a. 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.

      1) Required at horizontal assemblies,

b. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Penetrations in Smoke Barriers and Partitions: 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.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

2.5 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
2. Where indicated or required, provide the following:

a. T-Rating: At least one hour, but not less than the fire-resistance rating of adjacent construction.
b. W-Rating: Provide firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Joints at Exterior Curtain-Wall/Floor Intersections (Perimeter Fire Containment): Provide joint firestopping systems with rating determined per ASTM E2307.

1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
2. Where indicated or required, provide the following:

a. T-Rating: At least one hour, but not less than the fire-resistance rating of adjacent construction.
b. W-Rating: Provide firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

2.6 ACCESSORIES

A. General: For each firestopping system, provide all primers, forming/damming/backing materials, collars, sleeves, and related materials for a complete installation

B. Penetration Firestopping Systems: 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.

C. Joint Firestopping Systems: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

2.7 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete 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.

2.8 MIXING

A. Firestopping Materials: For those products requiring mixing before application, comply with 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 joint configurations, 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 and joint firestopping systems, clean out joints and openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of joints substrates and opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestopping materials or compromise fire-resistive rating.
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. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
4. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by 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 penetration and joint 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. Penetrations:

a. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.

b. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

2. Joints:

a. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
b. 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. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

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.

a. In occupied areas without ceilings do not apply labels.

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.

C. 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. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration and joint firestopping system is damaged or removed because of testing, repair or replace firestopping system to comply with requirements.

C. Proceed with enclosing penetration and 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 fill materials adjacent to openings and joints as the Work progresses by methods and with cleaning materials that are approved in writing by firestopping system manufacturers and that do not damage materials in which openings and joint occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration and joint 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 and joint firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 8413

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Silicone joint sealants.
2. Latex joint sealants.
3. Joint backings and accessories.

B. Related Sections include the following:

1. Section 07 8413 - Firestopping: For firestopping sealants.
2. Section 08 8000 - Glazing: For glazing sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency, installer, and manufacturer.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1. In addition, provide other sealant mockups not part of an assembly specified in other Sections when requested by the Architect.

a. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
b. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with installation, 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 manufacturing requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range, unless otherwise indicated.

2.2 PERFORMANCE REQUIREMENTS

A. Provide exterior joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

2.3 SILICONE JOINT SEALANTS

A. Silicone, Nonstaining – JS1:

1. ASTM C920, Type S, Grade NS, Class 50; Uses NT, A, G, M and O.

2. Non-Staining: No staining of substrates when tested according to ASTM C1248.
3. Cure Type: Single-component, neutral-curing.
4. Hardness Range: Comply with one of the following:

   a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
   b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.

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

   a. Dow Corning Corporation; 756 SMS Building **Sealant** or 790 Silicone Building Sealant: www.dowcorning.com.
   b. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: www.siliconeforbuilding.com.
   c. Pecora Corporation; 890NST: www.pecora.com.
   d. Sika Corporation; Sikasil WS-295 FPS: www.usa.sika.com.
   e. Tremco, Inc.; Spectrem 3: www.tremcosealants.com.

B. Silicone, Traffic Grade – JS2:

1. ASTM C920, Type S, Grade NS, Class 100/50; Uses T, M, and O.
2. Cure Type: Single-component, neutral-curing.
3. Hardness Range: Comply with one of the following:

   a. 5 to 15, Shore A, when tested in accordance with ASTM C661.
   b. 50 to 85, Shore 00, when tested in accordance with ASTM D2240.

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

   a. Dow Corning; NS Parking Structure Sealant: www.dowcorning.com.
   b. Pecora Corporation; 311NS: www.pecora.com.
   c. Sika Corporation; Sikasil - 728 NS: www.usa.sika.com.
   d. Tremco, Inc.; Spectrem 800: www.tremcosealants.com.

C. Silicone, Mildew-Resistant – JS3:

1. ASTM C920, Type S, Grade NS, Class 25; Uses NT, A, G, and O.
2. Mildew-Resistant: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
3. Cure Type: Single-component, acetoxy or neutral-curing.
4. Hardness Range: Comply with one of the following:

   a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
   b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.

5. Color: Clear.
6. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Corning; 786 Sealant M: www.dowcorning.com.
    b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: www.siliconeforbuilding.com.
    c. Pecora Corporation; 898NST: www.pecora.com.
    d. Sika Corporation; Sikasil - GP: www.usa.sika.com.
    e. Tremco, Inc.; Tremsil 200 with fungicide: www.tremcosealants.com.

2.4 LATEX JOINT SEALANTS

A. Acrylic Latex – JS4:

1. Acrylic latex or siliconized acrylic latex
2. ASTM C834, Type OP, Grade NF or Minus 18 Degrees C (0 Degrees F).
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Bostik, Inc.; PWC; www.bostik.com.
    b. Franklin International Inc; Titebond Painter's Plus Caulk: www.titebond.com.
    c. Pecora Corporation; AC-20 +Silicone: www.pecora.com.
    d. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
    e. Tremco, Inc.; Tremflex 834: www.tremcosealants.com.

B. Acrylic Latex, Acoustical Sealant – JS5:

1. Nonsag, paintable, nonstaining latex sealant. Reduces airborne sound transmission through perimeter joints and openings in wall assemblies.
2. ASTM C834
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: www.titebond.com.
    b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
    c. Pecora Corporation; AC-20 FTR: www.pecora.com.
    d. Pecora Corporation; AIS-919: www.pecora.com.
    e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant: www.usg.com.
    f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: www.usg.com.

2.5 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin) 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.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 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, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

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

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include, but are not limited to, the following:

   a. Concrete.
   b. Masonry.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include, but are not limited to, the following:

   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Cast-in-place Concrete:

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

D. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated or recommended by sealant manufacturer.

   a. Use masking tape to protect surfaces adjacent to tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Horizontal Traffic Surfaces:

1. Exterior Joints.

a. Joint Sealant: Silicone, Traffic-Grade – JS2.

1) Excludes joints in paved roads, parking lots, walkways, and curbing specified in Division 32.

2. Interior Joints:

a. Joint Sealant: Silicone, Traffic-Grade – JS2.

B. Vertical and Horizontal Nontraffic Surfaces:

1. Exterior Joints:

a. Joint Sealant: Silicone, Nonstaining – JS1.

2. Interior Joints:

a. Latex Joint Sealant: Acrylic Latex – JS4.

1) Joint Locations: All locations except as follows:

a) Tile joints; refer to Section 09 3000 Tiling, for nontraffic tile sealant.
b) Locations where silicone, nonstaining sealants are specified.
c) Locations where mildew-resistant silicone sealants are specified.
d) Locations where acoustic sealants are specified.

b. Silicone Joint Sealant: Silicone, Nonstaining – JS1.

1) Joint Locations:

a) Perimeter joints at exterior aluminum door frames and storefront framing.

c. Mildew-Resistant Joint Sealant: : Silicone, Mildew-Resistant – JS3

1) Joint Locations:

a) Joints between plumbing fixtures and adjoining walls, floors, and counters.
b) Joints between countertops and walls
c) Other joints as indicated on Drawings.

d. Acoustical Joint Sealant: Acrylic Latex, Acoustical Sealant – JS5.

1) Joint Locations: Gypsum board assemblies; refer to Section 09 2900 Gypsum Board.

END OF SECTION 07 9200

SECTION 08 1116 – ALUMINUM DOORS AND FRAMES

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. Interior aluminum framing systems.

a. Includes swing doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 COORDINATION

A. Switchable Privacy Glass: Coordinate with Section 08 8000 – Glazing, to accommodate wiring requirements and connections to power supplies for switchable privacy glass installed in interior aluminum framing systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum doors and framing systems:

1. Include elevations, sections, and installation details for each wall-opening condition.
2. Include details for each frame type, including dimensioned profiles and metal thicknesses.
3. Include locations of reinforcements and preparations for hardware.
4. Include details of anchorages, joints, field splices, connections, and accessories.
5. Include details of moldings, removable stops, and glazing.

C. Samples for Verification: For each type of exposed finish. Submit at least three samples of each of the following:

1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
2. Corner Fabrication and Finish: 12-by-12-inch-long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.

D. Product Schedule: For aluminum doors and framing systems. Use same designations indicated on Drawings. Coordinate with door hardware schedule and glazing.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum doors and framing systems to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.9 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. For each type of aluminum door and framing system, build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide Special-Lite, Inc.; LiteSpace: www.special-lite.com, or a comparable product from one of the following:

1. Frameworks Manufacturing: www.frameworks.com.
2. Versatrac: www.versatracframes.com.
3. Western Integrated Materials, Inc: www.aluminumdoorframes.com.

B. Source Limitations: Obtain aluminum door and framing systems from single source from single manufacturer.

2.2 COMPONENTS

A. Aluminum Framing: ASTM B221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.

1. Frames: Extruded aluminum, designed to accommodate glass up to 1//2 inch thick.

   a. Face: 1-3/4 inches.
   b. Depth: 2-3/8 inches.

2. Provide integrated door stops.
3. Frame and Trim Finish: Color-anodized aluminum.

B. Swing Doors: Manufacturer’s standard glazed aluminum doors.

1. Style: Wide style.

   a. Top Rail: 7-1/4 inches wide.
   b. Vertical Stiles: 5-1/2 inches wide.
   c. Bottom Rail: 10-3/4 inches wide.

2. Thickness: 1-3/4 inches.
3. Glazing Stops: Square.
4. Finish: Match adjacent interior aluminum framing system finish.

C. Door Hardware: Refer to Section 08 7100 – Door Hardware.

D. Glazing: Refer to Section 08 8000 - Glazing.

2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; in black.

2.4 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
4. Provisions for field replacement of glazing from the inside of spaces accessed by keyed doors.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Hardware Preparation: Factory prepare aluminum doors and frames to receive door hardware and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to the door schedule and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.

B. Anchor frames securely in place.

C. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.

1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
2. Secure clips to extruded main-frame components and not to snap-in or trim members.
3. Do not leave screws or other fasteners exposed to view when installation is complete.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 8000 – Glazing, and in accordance with aluminum doors and framing system manufacturer's written instructions.

3.4 ADJUSTING

A. Inspect installation, correct misalignments, and tighten loose connections.

B. Adjust doors and hardware, after installation, for proper operation.

C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 & 610.

D. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches as viewed by Architect.

1. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 08 1116

SECTION 08 1416 – FLUSH WOOD DOORS

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. Flush wood doors.

1.3 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. Factory-machining criteria.
6. 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. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

   a. Include corner sections of doors, with door faces and edges representing actual materials to be used.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

B. 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. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Delamination of veneer.
   b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eggers Industries, acquired by VT Industries, Inc. : www.eggersindustries.com.
2. Graham Wood Doors; Masonite Architectural: www.graham-maiman.masonite.com.
3. Marshfield-Algoma, Masonite Architectural: https://architectural.masonite.com.
4. Mohawk Doors, Masonite Architectural: https://architectural.masonite.com.
5. Oshkosh Door Company: www.oshkoshdoor.com.
6. VT Industries, Inc: www.vtindustries.com.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 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: Where indicated on Drawings and 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.

2.3 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Where the Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

1. Architectural Woodwork Standards Grade: Premium.
2. Faces: Single-ply wood veneer not less than 1/50 inch thick.

a. Species: Select Cherry.
b. Cut: Plain sliced/plain sawn.
c. Match between Veneer Leaves: Book match.
d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
f. Transom Match: Continuous match.

3. Exposed Vertical and Top Edges: Applied wood edges of same species as faces and covering edges of crossbands - Architectural Woodwork Standards edge Type D.

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.

4. Core for Non-Fire-Rated Doors:

   a. ANSI A208.1, Grade LD-2 particleboard.

      1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware and as follows:

         a) 5-inch top-rail blocking, in doors indicated to have closers.
         b) 5-inch bottom-rail blocking, in indicated to have protection plates.

   b. Provide doors with WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 7100 "Door Hardware."

      1) WDMA I.S. 10 structural composite lumber.

         a) Screw Withdrawal, Door Face: 550 lbf.
         b) Screw Withdrawal, Vertical Door Edge: 550 lbf.

5. 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 needed to eliminate through-bolting hardware and 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 exit devices or armor plates.

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

2.5 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: Flush rectangular beads, recessed tapered beads, or lipped tapered beads.
   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.

   1. Beads shall accommodate required glazing thicknesses; coordinate with Section 08 8000 – Glazing and Section 08 8813 – Fire Rated Glazing.

2.6 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.
3. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
4. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

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. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 "Glazing"
3. Louvers: Factory install louvers in prepared openings.

2.7 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. Architectural Woodwork Standards Grade: Premium.
2. Provide one of the following systems:

   a. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
   b. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
   c. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
   d. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.

3. Staining: Match Architect's sample.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install fire-rated doors in accordance with NFPA 80 requirements.

D. Install smoke and draft control doors in accordance with NFPA 105 requirements.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

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

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

END OF SECTION 08 1416

SECTION 08 3113 – ACCESS DOORS AND FRAMES

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. Access doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

D. Product Schedule: For access doors and frames.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide Bauco Access Panel Solutions, Inc.; Bauco Plus II: www.accesspanelsolutions.com, or a comparable product from one of the following:

1. Or approved equal.

2.2 MATERIALS

A. Extruded Aluminum: ASTM B221, Alloy 6063-T6

B. Gaskets: Manufacturer's standard EPDM.

C. Fasteners and Anchors: Zinc plated or stainless steel as standard with manufacturer.

2.3 ACCESS DOORS AND FRAMES

A. Recessed Access Doors with Concealed Flanges:

1. Locations: Gypsum board.
2. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. Door Size: As indicated on Drawings; otherwise provide in size as required for proper access of items behind access door.
4. Door

   a. Material: Extruded aluminum.

      1) Thickness: 0.125 inch.

   b. Corner Reinforcing: Galvanized steel.

5. Frame

   a. Material: Extruded aluminum.

      1) Thickness: 0.125 inch.

   b. Corner Reinforcing: Galvanized steel.
   c. Perimeter Gasketing: EPDM

6. Hardware:

   a. Hinge: Concealed free pivot hinge; galvanized steel.

      1) Allows door to open 120 degrees.
      2) Allows doors to be fully removed from frame.

   b. Latching: Concealed push-to-release/fasten latches.
   c. Safety Cable: Secures door to frame. 135 lb rated; with crimp connections and aluminum carabiner.

7. Aluminum Finish: Mill or clear anodized as standard with manufacturer.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports.

C. Ensure that flush panel door faces align with adjacent finish surfaces.

D. Ensure that recessed panel door faces are properly set to align applied infill material with adjacent finish surfaces.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 3113

SECTION 08 4113 – ALUMINUM-FRAMED STOREFRONTS

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. Relocation of existing aluminum-framed storefront systems.

a. Includes: Swing doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

PART 2 - PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONT SYSTEMS

A. Storefront Framing System: Reuse salvaged storefront framing system.

1. Includes aluminum swing doors.

2.2 GLAZING

A. Reuse salvaged glazing from salvaged storefront framing system.

2.3 ACCESSORIES

A. General: Provide all associated hardware, fasteners, and related components required for a complete installation.

B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.

C. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153 requirements.

D. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A240, of type recommended by manufacturer.

E. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation; unless otherwise recommended by aluminum-framed storefront manufacturer.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

3.4 INSTALLATION OF DOOR HARDWARE

A. Install door hardware as specified in Section 08 7100 – Door Hardware.

3.5 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 8000 - Glazing.

3.6 ERECTION TOLERANCES

A. Install aluminum-framed storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.

b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.7 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings on completion of installation, clean finished surfaces, including removing unused fasteners and related installation materials. Maintain storefront systems in a clean condition during construction.

B. Replace portions of storefront systems that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 08 4113

SECTION 08 4413 – GLAZED ALUMINUM CURTAIN WALLS

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. Glazed aluminum curtain wall systems.

a. Includes: Swing doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain wall systems. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For each type of factory-applied finishes.

1. Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips

D. Samples for Verification: For each type of exposed finish. Submit at least three samples of each of the following:

1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
2. Submit three samples of infill panels for each color and finish, not less than 6 inches square.

E. Delegated-Design Submittal: For each glazed aluminum curtain wall system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Qualification Data: For professional engineer.

C. Professional Engineer Qualifications: Professional engineer experienced with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.

D. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each For glazed aluminum curtain wall.

E. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. For each type of glazed aluminum curtain wall, build mockup of typical wall area as shown on Drawings.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glazed Aluminum Curtain Walls - Captured Glazing:

1. Basis of Design Product: Subject to compliance with requirements, provide Tubelite Inc, an Apogee Enterprises, Inc. company; 400 Series: www.tubeliteinc.com, or one of the following comparable products:

a. CMI Architectural; 6600 Wall: www.cmiarch.com.
b. EFCO Corporation, an Apogee Enterprises, Inc. company; System 5900: www.efcocorp.com.
c. Kawneer North American, an Arconic company; 1600 Wall System 1 Curtain Wall: www.kawneer.com
d. Oldcastle BuildingEnvelope; Reliance Curtain Wall: www.obe.com.
e. U. S. Aluminum, part of the C. R. Laurence Family of Companies; Series 2200: www.crl-arch.com.
f. YKK AP America, Inc.; YCW 700: www.ykkap.com.

B. Swing Door Manufacturers:

1. Any of the manufacturers specified for curtain wall products.

C. Source Limitations Obtain all components of curtain-wall system, including framing, doors and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Structural: Test in accordance with ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, curtain wall assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft..

G. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.42 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.

2. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.

3. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 60 as determined in accordance with AAMA 1503.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

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

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Curtain Wall System:

a. Framing Profile**:** 2-1/2 by 7-1/2 inches, nominal.
b. Construction: Thermally broken.
c. Glazing System: Retained mechanically with gaskets on four sides.
d. Glazing Plane: Front.
e. Finish: Clear anodic finish.
f. System: Stick system.
g. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
h. Steel Reinforcement: As required by manufacturer.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 SWING DOORS

A. Swing Doors: Manufacturer’s standard glazed aluminum doors.

1. Style: Wide style.

a. Top Rail: 5 inches wide.
b. Vertical Stiles: 5 inches wide.
c. Bottom Rail: 10 inches wide.

2. Thickness: 1-3/4 inches.
3. Glazing Stops: Square.
4. Finish: Match adjacent curtain wall framing finish.

B. Hardware:

1. For each door, include manufacturer's standard weatherstripping and sill sweep strip.

   a. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
   b. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.

2. Other Door Hardware: As specified in Section 08 7100 – Door Hardware.

2.5 GLAZING

A. Glazing: As specified in Section 08 8000- Glazing.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36.
2. Cold-Rolled Sheet and Strip: ASTM A1008.
3. Hot-Rolled Sheet and Strip: ASTM A1011.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153 requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A240, of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal perimeter and other joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

3.4 INSTALLATION OF DOOR HARDWARE

A. Install door hardware as specified in Section 08 7100 – Door Hardware.

3.5 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 8000 - Glazing.

3.6 ERECTION TOLERANCES

A. Install glazed aluminum curtain wall systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.7 FIELD QUALITY CONTROL

A. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

   a. Perform testing prior to 10, 35, and 70 percent completion.

      1) At each stage of completion, perform a minimum of three tests in up to three areas as directed by Architect.

2. At Owner's discretion, engage testing agency to perform additional tests and inspections.

   a. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   b. Frequency: For each major façade or elevation:

      1) Perform testing prior to 10, 35, and 70 percent completion.

         a) At each stage of completion, perform testing in up to three areas as directed by Architect.

   c. Testing to include the following:

      1) Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft.at a static-air-pressure differential of 6.24 lbf/sq. ft.
      2) Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft, and shall not evidence water penetration.

B. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

3.9 CLEANING AND PROTECTION

A. Remove temporary protective coverings on completion of installation, clean finished surfaces, including removing unused fasteners and related installation materials. Maintain glazed aluminum curtain walls in a clean condition during construction.

B. Replace portions of glazed aluminum curtain walls that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 08 4413

SECTION 08 7100 - 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. Section Includes:

1. Hardware for hollow metal, wood, aluminum, and FRP-faced aluminum doors.
2. Electrically operated and controlled hardware.
3. Cylinders for doors or locks specified in other Sections.

B. Door hardware set schedules included at end of this section.

1.3 REFERENCE STANDARDS

A. References:

1. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
2. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
3. BHMA (CPD) - Certified Products Directory Current Edition.
4. BHMA A156.1 - American National Standard for Butts and Hinges 2016.
5. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches 2017.
6. BHMA A156.3 - American National Standard for Exit Devices 2014.
7. BHMA A156.4 - American National Standard for Door Controls - Closers 2013.
8. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks 2014.
9. BHMA A156.6 - American National Standard for Architectural Door Trim 2015.
10. BHMA A156.7 - American National Standard for Template Hinge Dimensions 2016.
11. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders 2015.
12. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000 2017.
13. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical 2015.
14. BHMA A156.16 - American National Standard for Auxiliary Hardware 2018.
15. BHMA A156.18 - American National Standard for Materials and Finishes 2016.
16. BHMA A156.21 - American National Standard for Thresholds 2014.
17. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems Sponsor 2017.
18. BHMA A156.23 - American National Standard for Electromagnetic Locks 2017.
19. BHMA A156.26 - American National Standard for Continuous Hinges 2017.
20. BHMA A156.28 - American National Standard for Recommended Practices for Mechanical Keying Systems 2018.
21. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
22. BHMA A156.115W - American National Standard for Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.
23. DHI (KSN) - Keying Systems and Nomenclature 1989.
24. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.
25. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.
26. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
27. ITS (DIR) - Directory of Listed Products current edition.

28. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
29. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
30. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
31. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2019.
32. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
33. UL (DIR) - Online Certifications Directory Current Edition.
34. UL 1034 - Standard for Burglary-Resistant Electric Locking Mechanisms 2015.
35. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.
36. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
37. UL 294 - Access Control System Units Current Edition, Including All Revisions.
38. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Attendance is required by affected installers and the following:

   a. Architect.
   b. Hardware Installer.
   c. Owner's Security Consultant.

2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Inspect and discuss preparatory work performed by other trades.
4. Inspect and discuss electrical roughing-in for electrified door hardware.
5. Review sequence of operation for each type of electrified door hardware.
6. Review required testing, inspecting, and certifying procedures.
7. Review questions or concerns related to proper installation and adjustment of door hardware.

B. Electrified Hardware Coordination Conference:

1. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

C. Keying Requirements Meeting: Conduct conference at Project site.

1. Attendance is required by the following:

   a. Owner.
   b. Architect.
   c. Hardware Installer.
   d. Owner's Security Consultant.

2. Establish keying requirements. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
   e. Address for delivery of keys

1.5 COORDINATION

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where 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 proper door operation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.

1. List and describe each opening separately; include doors with identical hardware, except hand, in single heading. Include door number, room designations, degree of swing, and hand.
2. List hardware items; include manufacturer's name, quantity, product name, catalog number, size, base metal, finish, fasteners, and related details where applicable.
3. List related details; include dimensions, door and frame material and other conditions affecting hardware.
4. Electrified Door Hardware:

a. Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:

1) Submit front and back elevations of each door opening showing electrified devices with connections installed.
2) Submit operations narrative describing how opening operates from either side at any given time.
3) Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

C. Samples for Verification: Provide upon Architect’s request; for each type of exposed product, in each finish specified.

1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.
2. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

E. Keying Schedule:

1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

1.7 INFORMATIONAL SUBMITTALS

A. Manufacturer's Qualification Statement.

B. Installer's Qualification Statement.

C. Architectural Hardware Consultant (AHC) inspection reports.

D. Product Certificates:

1. For each type of electrified door hardware.

2. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

E. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

F. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

C. Schedules: Final door hardware and keying schedule.

1.9 MAINTENANCE MATERIAL

A. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least five years of documented experience and approved by manufacturer, and shall have on staff an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

C. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.11 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.12 WARRANTY

A. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Butt Hinges: One year, minimum.
2. Continuous Hinges: Lifetime, minimum.
3. Exit Devices and Trim: Three years, minimum.

   a. Electrified Exit Device Components: One year, minimum.

4. Locksets and Cylinders: Three years, minimum.

   a. Electrified Lockset Components: One year, minimum.

5. Closers: Thirty years, minimum.
6. Overhead stops and holders: One year, minimum.
7. Other Hardware: One year, minimum.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:

1. Listed and certified compliant with specified standards by BHMA (CPD).
2. Applicable provisions of federal, state, and local codes.
3. Applicable provisions of NFPA 101.
4. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
5. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

   a. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

6. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

   a. Listed and classified by UL (DIR) as suitable for the purpose specified.
   b. Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection.

7. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

8. Accessibility: ADA Standards and ICC A117.1.

    a. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
    b. Comply with the following maximum opening-force requirements:

        1) Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
        2) Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
        3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

    c. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
    d. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
    e. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

9. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
10. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.

D. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.

    a. Aluminum fasteners are not permitted.
    b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.

2. Fire-Rated Applications: Comply with NFPA 80.

2.2 BUTT HINGES

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Bommer Industries, Inc: www.bommer.com.
2. Hager Companies: www.hagerco.com.
3. Ives; an Allegion company: www.us.allegion.com
4. McKinney; an Assa Abloy Group company: www.assaabloydss.com.
5. Stanley; a Dormakaba Group company: www.stanleyhardwarefordoors.com.

B. Butt Hinges: Comply with BHMA A156.1, Grade 1.

1. Templated Hinges: Comply with BHMA A156.7.
2. Provide hinge width as required to clear surrounding trim.
3. Provide butt hinges on every swinging door unless otherwise indicated.

    a. Provide five-knuckle full mortise butt hinges unless otherwise indicated.

        1) Provide ball-bearing hinges at each door.

    b. Provide stainless steel hinges at exterior doors.

        1) Provide non-removable pins at outswinging exterior doors.

    c. Provide heavy weight hinges at fire rated doors.

4. Provide following quantity of butt hinges for each door:

   a. Door Height - Up to 60 inches: Two hinges.
   b. Door Height - 60 to 90 inches: Three hinges.
   c. Door Height - 90 to 120 inches: Four hinges.
   d. Door Height - Over 120 inches: One additional hinge per each additional 30 inches in height.

5. For 1-3/4 inch thick doors, provide following butt hinge sizes:

   a. Doors up to 36 inches wide: 4-1/2 high x 4-1/2 wide.
   b. Doors 36 to 48 inches wide: 5 high x 4-1/2 wide.
   c. Doors over 48 inches wide: 6 high x 5 wide.

2.3 CONTINUOUS HINGES

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Architectural Builder's Hardware Mfg. Inc.: www.abhmfg.com.
2. Bommer Industries, Inc: www.bommer.com.
3. Hager Companies: www.hagerco.com.
4. Ives Hardware; an Allegion company: www.us.allegion.com
5. McKinney; an Assa Abloy Group company: www.assaabloydss.com.
6. SELECT Products Limited: www.select-hinges.com.
7. Stanley; a Dormakaba Group company: www.stanleyhardwarefordoors.com.

B. Continuous Hinges: Complying with BHMA A156.26, Grade 1.

1. Provide continuous hinges on every aluminum swinging door and frame unless otherwise indicated.

   a. Provide aluminum geared hinges.

      1) Flush Mounted.
      2) Heavy duty.

   b. Cap Finish: Color and finish to match door and frame, unless otherwise indicated.

2.4 EXIT DEVICES

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Sargent; an Assa Abloy Group company: www.assaabloydss.com.
2. Von Duprin; an Allegion company: www.us.allegion.com,

B. Exit Devices: Complying with BHMA A156.3, Grade 1.

1. Provide exit devices in functions as specified in hardware sets.
2. Lever Style: To match Von Duprin Style 07.

   a. Provide vandal resistant outside trim.

3. Provide dogging on non-rated devices.

   a. Hex key dogging.
   b. Where indicated, provide cylinder dogging instead of hex key dogging.

4. Provide exit devices properly sized for door width and height.

5. Provide strike as recommended by manufacturer for application indicated.
6. Provide less bottom rod (LBR) at scheduled locations to eliminate use of floor mounted strikes.
7. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
8. Where indicated, provide electrified exit devices that comply with above requirements and as follows:

    a. Voltage: 24 VDC.

        1) Provide power supplies by same manufacturer as exit devices.

    b. Provide fail-secure exit devices unless otherwise indicated.
    c. Provide electrified exit devices from same manufacturer as mechanical exit devices.
    d. For electrical options, provide quick connect plug-in pre-wired connectors.

2.5 CYLINDERS AND CORES

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

1. Provide small format interchangeable core (SFIC) type cylinders, Grade 1, with seven-pin core in compliance with BHMA A156.5.

    a. Provide cylinders from same manufacturer as locking device.
    b. Provide all cores from one supplier regardless of door type, locking device, and location.

        1) Core manufacturer, brand, and model shall match Owner's existing products; key to existing keying system.

    c. Provide cams and/or tailpieces as required for locking devices.

2. Construction Cores:

    a. Provide disposable or keyed construction cores for use during construction period.

        1) Prior to Owner occupancy and near the end of the construction period, replace construction cores with permanent cores.

2.6 KEY CONTROL SYSTEMS

A. Manufacturers:

1. Key control system manufacturer shall be the same as the core manufacturer.

B. Key Control Systems: Complying with guidelines of BHMA A156.28.

1. Provide keying information in compliance with DHI (KSN) standards.
2. Hardware Supplier shall meet with Owner to finalize master keying system requirements and obtain any special keying instructions.
3. Keying: Grand master keyed.
4. Include keying of construction cores.
5. Supply keys in following quantities:

    a. Change Keys per cylinder or keyed alike group; 3.
    b. Master Keys; 2 per master key group.
    c. Grand Master Key; 2 per grand master key group.
    d. Construction Core Keys per cylinder or keyed alike group; 2.

2.7 MORTISE LOCKSETS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Schlage; an Allegion company: www.us.allegion.com
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com.

B. Mortise Locks: Complying with BHMA A156.13, Grade 1, Security, 1000 Series.

1. Provide locks and latch sets in functions as specified in hardware sets.
2. Trim: Provide lever handle and rose, unless otherwise indicated.

   a. Lever Style: To match Schlage Style 07.
   b. Rose Style: To match Schlage Style A.

3. Provide vandal resistant locks with freely rotating levers in all locking functions.
4. Provide locks that comply with ICC A117.1 accessibility standards.
5. Provide locks with corrosion-resistant steel case and components.
6. Latchbolt Throw: 3/4 inch, minimum.
7. Deadbolt Throw: 1 inch, minimum.
8. Backset: 2-3/4 inch unless otherwise indicated.
9. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.

   a. Finish: To match lock or latch.

10. Where indicated, provide occupancy indicators.
11. Where indicated, provide electrified locksets that comply with above requirements.

    a. Voltage: 24 VDC.

       1) Provide power supplies by same manufacturer as lockset.

    b. Provide fail-secure locksets unless otherwise indicated.
    c. Provide electrified locksets from same manufacturer as mechanical locksets.
    d. For electrical options, provide quick connect plug-in pre-wired connectors.

2.8 TWO-POINT LOCKSETS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Schlage; an Allegion company: www.us.allegion.com
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com.

B. Two-point Locksets:

1. Locksets shall have concealed vertical cables or rods controlling top and bottom latching.

   a. Where indicated, delete the bottom latch.

2. Provide locks and latch sets in functions as specified in hardware sets.
3. Lever style to match other locksets.
4. Provide locks that comply with ICC A117.1 accessibility standards.
5. Provide strikes as recommended by manufacturer for application indicated.
6. Where indicated, provide electrified locksets that comply with above requirements.

   a. Voltage: 24 VDC.

b. Provide fail-secure locksets unless otherwise indicated.
c. Provide electrified locksets from same manufacturer as mechanical locksets.

2.9 DOOR PULLS AND PUSH BARS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. DORMA USA, Inc.; a Dormakaba Holding Inc. company; www.dorma.com.
2. Hager Companies: www.hagerco.com.
3. Ives, an Allegion company: www.allegion.com/us.
4. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
5. Trimco: www.trimcohardware.com.

B. General:

1. Material: Stainless steel, unless otherwise indicated.
2. Bar Size: 1 inch round, unless otherwise indicated.
3. Mounting: Provide back-to-back bar mounting or decorative thru-bolt at non back-to-back locations, unless otherwise indicated.

a. Decorative blind thru-bolt shall be similar to Ives Type O Mount.

C. Door Offset Pull: Complying with BHMA A156.6.

1. Pull Type: Offset pull bar.
2. Center to Center Size: 10 inches.
3. Mounting: Decorative blind thru-bolt similar to Ives Type O Mount.

2.10 CLOSERS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. LCN; an Allegion company: www.us.allegion.com
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com.

B. Closers: Complying with BHMA A156.4, Grade 1.

1. Type: Surface mounted to door; heavy duty.
2. Provide closers for fire-rated doors in compliance with UL 10C.
3. Comply with ICC A117.1 accessibility standards.
4. Provide metal covers.
5. Provide closers with adjustable swing speed, latching speed, and backcheck features.
6. Provide mounting brackets, drop plates, and any other associated hardware or accessories required by door and frame conditions.
7. Provide rust inhibiting coating on closers at the following locations:

a. Exterior doors.
b. Other doors as indicated.

8. Provide door closers on the following doors:

a. Each exterior door.
b. Each fire-rated and smoke-rated door.
c. Other doors as indicated.

9. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

10. Mounting locations: Mount closers as follows:

    a. At corridor entry doors, mount closer on room side of door.
    b. At exterior doors, mount closer on interior side of door.

2.11 OVERHEAD STOPS AND HOLDERS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Architectural Builder's Hardware Mfg. Inc.: www.abhmfg.com.
2. Hager Companies: www.hagerco.com.
3. DORMA USA, Inc.; a Dormakaba Holding Inc. company; www.dorma.com.
4. Glynn-Johnson; an Allegion company: www.us.allegion.com
5. Rixson; an Assa Abloy Group company: www.assaabloydss.com.
6. Rockwood; an Assa Abloy Group company: www.assaabloydss.com

B. Overhead Stops and Holders (Door Checks): Complying with BHMA A156.8, Grade 1.

1. Provide overhead stop or holder at doors that are capable of swinging more than 110 degrees before striking wall or where door will strike fixed object such as sink, cabinet, and similar obstructions.
2. Provide overhead stop or holder at all outswinging exterior doors where indicated and at other locations as indicated.

    a. Stops and holders at exterior doors shall be stainless steel.

3. Stops and holders shall be heavy duty,, overhead mounted stops and holders unless otherwise indicated.

    a. Provide overhead holders only where indicated, otherwise provide an overhead stop.
    b. Provide overhead stops at fire-rated doors; overhead holders are prohibited.

4. Stops used in conjunction with automatic door operators shall not include a shock-absorbing mechanism.

2.12 PROTECTION PLATES

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Ives; an Allegion company: www.us.allegion.com
2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com
3. Trimco: www.trimcohardware.com.
4. Hager Companies: www.hagerco.com.

B. Protection Plates - General: Complying with BHMA A156.6.

1. Includes the following:

    a. Kick plates.

2. Metal Properties: Stainless steel.

    a. Metal, Standard Duty: Thickness 0.05 inch, minimum.

3. Edges: Beveled, on four sides unless otherwise indicated.
4. Fasteners: Countersunk screw fasteners.

C. Kick Plates:

1. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.

a. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.13 ELECTROMAGNETIC DOOR HOLDERS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. LCN; an Allegion company: www.us.allegion.com
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com.

B. Electromagnetic Door Holders: Complying with BHMA A156.15.

1. Type: Wall, floor or ceiling mounted as indicated in Hardware Set Schedule, single unit, standard duty, with strike plate attached to door.

a. Low-profile, recess mounted.
b. Provide armature extensions as required to meet wall and hardware conditions and to maintain proper clearances and operation.

2. Holding Force, Standard Duty: 35 lbs-force, minimum.
3. Voltage: 24 VDC.
4. Fail safe; door released to close automatically when electrical current is interrupted.

2.14 WALL STOPS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Ives; an Allegion company: www.us.allegion.com
2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
3. Trimco: www.trimcohardware.com.
4. Hager Companies: www.hagerco.com.

B. Wall Stops: Complying with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.

1. Provide wall stops to prevent damage to wall surface upon opening door.
2. Type: Provide one of the following as indicated in hardware sets.

a. Bumper, concave, wall stop.
b. Sloped wedge-shaped wall stop with bumper.

3. Material: Heavy duty cast brass housing with rubber bumper.
4. Fasteners: As appropriate for substrates indicated on Drawings.

2.15 THRESHOLDS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. National Guard Products, Inc.: www.ngpinc.com.
2. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
3. Reese Enterprises, Inc.; www.reeseusa.com.
4. Zero International, Inc., an Allegion company: www.zerointernational.com.

5. Hager Companies: www.hagerco.com.

B. Thresholds - Saddle: Complying with BHMA A156.21.

1. Provide threshold at each exterior door, unless otherwise indicated.
2. Type: Saddle.
3. Material: Aluminum.
4. Threshold Surface: Fluted horizontal grooves across full width.
5. Comply with ICC A117.1 for barrier free threshold requirements.
6. Stop Strip: Where indicated, provide an applied stop strip.

   a. Weatherstripping material: Santoprene.
   b. Comply with ASTM E283 for air infiltration.

7. Field cut threshold to profile of frame and width of door sill for tight fit.
8. Provide non-corroding fasteners at all locations.

2.16 WEATHERSTRIPPING AND GASKETING

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. National Guard Products, Inc: www.ngpinc.com.
2. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
3. Reese Enterprises, Inc.; www.reeseusa.com.
4. Zero International, Inc., an Allegion company: www.zerointernational.com.
5. Hager Companies: www.hagerco.com.

B. Weatherstripping: Complying with BHMA A156.22.

1. Head and Jamb Type: Encased in retainer.
2. Material: Aluminum, with neoprene weatherstripping
3. Comply with ASTM E283 for air infiltration.
4. Comply with UL 10B and UL 10C for fire rated doors.
5. Provide weatherstripping on each exterior door at head and jambs, unless otherwise indicated. Weatherstripping shall be continuous without gaps.

C. Fire and Smoke Gasketing (and Acoustical): Complying with BHMA A156.22.

1. Head and Jamb Type: Self-adhesive.
2. Material: Silicone bulb gasketing.
3. Comply with ASTM E283 for air infiltration.
4. Comply with UL 10B and UL 10C for fire rated doors.
5. Provide gasketing on each fire or smoke rated door at head and jambs, unless otherwise indicated. Gasketing shall be continuous without gaps.

2.17 SWEEPS, DOOR BOTTOMS, AND SHOES

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. National Guard Products, Inc: www.ngpinc.com.
2. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
3. Reese Enterprises, Inc.; www.reeseusa.com.
4. Zero International, Inc., an Allegion company: www.zerointernational.com.
5. Hager Companies: www.hagerco.com.

B. Bottom Sweeps: Complying with BHMA A156.22.

1. Door Sweep Type: Encased in retainer.
2. Material: Aluminum, with neoprene weatherstripping
3. Comply with ASTM E283 for air infiltration.
4. Comply with UL 10B and UL 10C for fire rated doors.
5. Bottom sweep shall be continuous across entire length of door bottom.
6. Provide door bottom sweep on each exterior door, unless otherwise indicated.
7. Provide non-corroding fasteners at all locations.

2.18 ELECTRIC POWER TRANSFERS

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. Securitron; an Assa Abloy Group company: www.assaabloydss.com.
2. Von Duprin; an Allegion company: www.us.allegion.com

B. Electrified Power Transfer: Provide concealed mortised electric power and data transfer device; provides connection between frame and door with sufficient number and gage of conductors to accommodate function of hardware specified.

1. Material: Aluminum or steel.

2.19 DOOR POSITION SWITCHES

A. Basis-of-Design: Subject to compliance with requirements, provide products indicated in hardware sets or a comparable product from one of the following:

1. United Technologies Corp. / Interlogix: www.interlogix.com.
2. Rutherford Controls International (RCI); a Dormakaba Group company: www.dormakaba.com.
3. Schlage; an Allegion company: www.us.allegion.com
4. Securitron; an Assa Abloy Group company: www.assaabloydss.com.
5. Hager Companies: www.hagerco.com.

B. Door Position Switches: Concealed magnetic door position switches used to detect the open or closed status of doors.

1. Power: 24 VDC.

a. Provide power supplies by same manufacturer as locking device.

2. SPDT; single pole, double throw.

2.20 FINISHES

A. Finishes: Identified in Hardware Set Schedule in Part 3 of this Section.

B. Comply with BHMA A156.18.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

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: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Install hardware for smoke and draft control doors in accordance with NFPA 105.

D. Use templates provided by hardware item manufacturer.

E. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

F. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

G. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

H. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

L. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing.

B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

1. AHC shall be provided by Contractor.
2. AHC shall provide a written inspection report.

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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

C. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper function and finish.

D. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

E. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.8 DOOR HARDWARE SET SCHEDULE - GENERAL

A. General:

1. Hardware schedule lists primary components of a hardware set. Provide all associated hardware, including, but not limited to, fasteners, extensions, drop plates, mounting brackets, and electrical components and wiring for a complete, coordinated, and properly operating installation.
2. Where hardware sets indicate a balance of existing hardware to remain, Contractor shall field verify and confirm existing door hardware products, manufacturers and model numbers, door preparation, and any other items or aspects of the existing conditions as needed to complete work of this section.

B. Manufacturer abbreviations used in Hardware Schedule:

1. GJ: Glynn-Johnson; an Allegion company: www.us.allegion.com.

2. IVE: Ives; an Allegion company: www.us.allegion.com.
3. LCN: LCN; an Allegion company: www.us.allegion.com.
4. NGP: National Guard Products, Inc.: www.ngpinc.com.
5. SCH: Schlage; an Allegion company: www.us.allegion.com.
6. VD: Von Duprin; an Allegion company: www.us.allegion.com.

C. Hardware Set Schedule Format:

1. Hardware sets are described in schedule(s) as follows:

SET NO. Hardware set number

Doors: Door numbers belonging to this hardware set; separated by forward slashes.

Quantity	Item Description	Model	BHMA Finish Numbers	Manufacturer Abbreviation
Quantity	Item Description	Model	BHMA Finish Numbers	Manufacturer Abbreviation
Quantity	Item Description	Model	BHMA Finish Numbers	Manufacturer Abbreviation
Quantity	Item Description	Model	BHMA Finish Numbers	Manufacturer Abbreviation

Description of Door's Sequence of Operation

3.9 HARDWARE SET SCHEDULE

SET NO. 01

Doors: 1HW2

3	HINGES	5BB1HW	625	IVE
1	POWER TRANSFER	EPT-10	689	VD
1	LOCKSET	L9092EU RX (FAIL SECURE)	625	SCH
1	CYLINDER + CORE	---	625	---
1	MAGNETIC HOLDER	SEM7840/7850 AS REQ'D (WALL MOUNTED)	689	LCN
1	CLOSER	4011	625	LCN
1	KICK PLATE	8400	630	IVE
1	DR POSITION SWITCH	679-05 WD	BLACK	SCH
1	POWER SUPPLY	BY SECURITY CONTRACTOR	---	---
1	CARD READER	BY SECURITY CONTRACTOR	---	---
1	PUSH RELEASE BUTTON	BY SECURITY CONTRACTOR	---	---

PRESENTATION OF AUTHORIZED CREDENTIAL MOMENTARILY UNLOCKS LOCKSET ALLOWING ENTRY. LOCKSET REQUEST TO EXIT (RX) SHUNTS DOOR POSITION SWITCH ALLOWING FREE EGRESS AT ALL TIMES.

MAGNETIC HOLDER HOLDS DOOR IN OPEN POSITION WHEN DOOR IS FULLY OPENED. DOOR IS RELEASED BY MANUALLY PULLING DOOR CLOSED OR BY PUSH BUTTON RELEASE AT A REMOTE LOCATION.

SET NO. 02

Doors: 1MR1 /119B

3	HINGES	5BB1HW	625	IVE
1	LATCHSET	L9010 (PASSAGE)	625	SCH
1	CONC OVHD STOP	100S	629	GJ

SET NO. 03

Doors: 1TR1 / 1TR2 / 1TR3

3	HINGES	5BB1HW	625	IVE
1	LOCKSET	L9496 (PRIVACY WITH OCCUPIED INDICATOR)	625	SCH
1	CYLINDER + CORE	---	625	---
1	CLOSER	4011	625	LCN
1	KICK PLATE	8400	630	IVE
1	WALL STOP	WS402CCV	625	IVE

SET NO. 04

Doors: 1VB1

1	CONT HINGE	112HD EPT (CAP TO MATCH FRAMING)	628	IVE
1	OFFSET PULL	8190HD	630	IVE
1	EXIT DEVICE	QEL-RX-98-NL-OP	625	VD
1	CYLINDER + CORE	---	625	---
1	CLOSER	4111 EDA SRI	625	LCN
1	CONC OVHD STOP	100S	629	GJ
1	WEATHERSTRIPPING	700NA	628	NGP
1	THRESHOLD	425	MILL	NGP
1	DR POSITION SWITCH	7766	628	SCH
1	POWER SUPPLY	BY SECURITY CONTRACTOR	---	---
1	CARD READER	BY SECURITY CONTRACTOR	---	---
1	BOLLARD POST	8310-866 (CARD READER MOUNT)	689	LCN

PRESENTATION OF AUTHORIZED CREDENTIAL MOMENTARILY RETRACTS EXIT DEVICE LATCH ALLOWING ENTRY. EXIT DEVICE REQUEST TO EXIT (RX) SHUNTS DOOR POSITION SWITCH ALLOWING FREE EGRESS AT ALL TIMES.

SET NO. 05

Doors: 1VB1A / 122

SALVAGED HARDWARE, DOOR, AND FRAME SHALL BE REINSTALLED AT NEW LOCATION AS INDICATED ON DRAWINGS .

SET NO. 06

Doors: 1WR1

3	HINGES	5BB1HW	625	IVE
1	LATCHSET	L9010 (PASSAGE)	625	SCH
1	CLOSER	4011	625	LCN
1	WALL STOP	WS402CCV	626	IVE

SET NO. 07

Doors: 1WR1A / 118A

3	HINGES	5BB1HW	625	IVE
1	LATCHSET	L9010 (PASSAGE)	625	SCH
1	WALL STOP	WS402CCV	625	IVE

SET NO. 08

Doors: 118

2	CONT HINGES	112HD EPT (CAP TO MATCH FRAMING)	628	IVE
1	TWO PT EXIT LOCK	LM9225 RX LBL	625	SCH
1	TWO PT EU MORT LOCK	LM9292EU RX LBL (FAIL SECURE)	625	SCH
1	CYLINDER + CORE	---	625	---
2	CLOSERS	4111	625	LCN
2	MAGNETIC HOLDERS (CEILING MOUNTED)	SEM7820 (CEILING MOUNTED)	689	IVE
2	DR POSITION SWITCH	679-05	BLACK	SCH
1	POWER SUPPLY	BY SECURITY CONTRACTOR	---	---
1	PUSH RELEASE BUTTON	BY SECURITY CONTRACTOR	---	---

PRESENTATION OF AUTHORIZED CREDENTIAL MOMENTARILY UNLOCKS LOCKSET ALLOWING ENTRY. LOCKSET REQUEST TO EXIT (RX) SHUNTS LOCKSET DOOR POSITION SWITCH ALLOWING FREE EGRESS AT ALL TIMES.

MAGNETIC HOLDERS HOLDS DOORS IN OPEN POSITION WHEN DOORS ARE FULLY OPENED. DOORS ARE RELEASED BY MANUALLY PULLING DOORS CLOSED OR BY PUSH BUTTON RELEASE AT A REMOTE LOCATION

COORDINATE POWER TRANSFER REQUIREMENTS WITH SWITCHABLE PRIVACY GLASS; REFER TO SECTION 08 8000 – GLAZING.

SET NO. 09

Doors: 119

6	HINGES	5BB1HW	625	IVE
2	POWER TRANSFERS	EPT-10	689	VD
1	TWO PT EXIT LOCK	LM9225 RX LBL	625	SCH
1	TWO PT EU MORT LOCK	LM9292EU RX LBL (FAIL SECURE)	625	SCH
1	CYLINDER + CORE	---	625	---
2	CLOSERS	4111	625	LCN
2	CONC OVHD STOPS	100S	629	GJ
2	KICK PLATES	8400	630	IVE
2	DR POSITION SWITCH	679-05 WD	BLACK	SCH
1	POWER SUPPLY	BY SECURITY CONTRACTOR	---	---
1	CARD READER	BY SECURITY CONTRACTOR	---	---

PRESENTATION OF AUTHORIZED CREDENTIAL MOMENTARILY UNLOCKS LOCKSET ALLOWING ENTRY. LOCKSET REQUEST TO EXIT (RX) SHUNTS LOCKSET DOOR POSITION SWITCH ALLOWING FREE EGRESS AT ALL TIMES.

SET NO. 10

Doors: 119A

1	CONT HINGE	224HD EPT (CAP TO MATCH FRAMING)	628	IVE
1	LOCKSET	L9092EU RX (FAIL SECURE)	625	SCH
1	CYLINDER + CORE	---	625	---
1	MAGNETIC HOLDER	SEM7820 (FLOOR MOUNTED)	689	LCN
1	CLOSER	4111	625	LCN
1	DR POSITION SWITCH	679-05 WD	BLACK	SCH
1	POWER SUPPLY	BY SECURITY CONTRACTOR	---	---
1	CARD READER	BY SECURITY CONTRACTOR	---	---
1	PUSHBUTTON	BY SECURITY CONTRACTOR	---	---

PRESENTATION OF AUTHORIZED CREDENTIAL MOMENTARILY UNLOCKS LOCKSET ALLOWING ENTRY. LOCKSET REQUEST TO EXIT (RX) SHUNTS DOOR POSITION SWITCH ALLOWING FREE EGRESS AT ALL TIMES.

MAGNETIC HOLDER HOLDS DOOR IN OPEN POSITION WHEN DOOR IS FULLY OPENED. DOOR IS RELEASED BY MANUALLY PULLING DOOR CLOSED OR BY PUSH BUTTON RELEASE AT A REMOTE LOCATION.

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Monolithic glazing.
2. Laminated glazing.
3. Insulating glazing.
4. Switchable privacy glass.
5. Curved/radius glazing.
6. Miscellaneous glazing materials.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

B. Switchable Privacy Glass: Coordinate with Section 08 1116 – Aluminum Doors and Frames, to accommodate wiring requirements and connections to power supplies for switchable privacy glass installed in interior aluminum framing systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Wiring diagrams for switchable privacy glass.

C. Samples:

1. Glass Samples: Submit three samples 12 by 12 inch in size for each glass type.

   a. Non-insulated types may be 4 by 4 inches in size.
   b. Includes switchable privacy glass

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, primary glass manufacturer, and fabricated-glass manufacturer.

B. Product Certificates: For glass.

C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. GANA Publications: “GANA Sealant Manual.”
3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Delegated Design: Engage a qualified professional engineer licensed in the State in which the Project is located to design glazing.

C. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.

D. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

E. Source Limitations for Glass:

1. Obtain clear float glass from single source from single manufacturer.
2. Obtain tinted and coated glass from single source from single manufacturer.
3. Obtain laminated glass and insulated glazing units from a single source from a single fabricator.

F. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

G. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in the following sections:

   a. Section 08 1116 – Interior Aluminum Door and Frames.
   b. Section 08 4413 - Glazed Aluminum Curtain Walls.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

E. Manufacturer's Special Warranty for Switchable Privacy Glass: Manufacturer agrees to replace switchable privacy-glass units that fail in materials, performance, or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS MANUFACTURERS

A. Float Glass Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Guardian Glass, LLC: www.guardianglass.com.
2. Pilkington North America Inc: www.pilkington.com.
3. Viracon, Inc: www.viracon.com.
4. Vitro Architectural Glass (formerly PPG Industries, Inc.): www.vitroglazings.com.

B. Laminated Glass Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Any of the manufacturers specified for float glass or a fabricator approved by one of the specified float glass manufacturers.

C. Insulating Glass Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Any of the manufacturers specified for float glass or a fabricator approved by one of the specified float glass manufacturers.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Thickness: Indicated glass thicknesses are minimums. Provide glass that complies with performance requirements and load designs, and is not less than the thickness indicated.

C. Glass Strength:

1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with performance requirements.
2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with performance requirements.

D. Glass Distortion Tolerances:

1. Roller Wave: Maximum 0.003 inch from peak to valley within the main body of the sheet and maximum 0.008 inch within 10.5 inches of a leading or trailing edge.
2. Localized Warp: Maximum 0.03 inch over any 12 inch span, but limited to 0.31 inch.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

F. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated, including assembly dead loads and live loads, in accordance with local building codes and ASTM E1300.

1. Design Wind Pressures: Determine design wind pressures applicable to Project in accordance with ASCE/SEI 7, and as indicated on Drawings.

2. Probability of Breakage for Glass Sloped:

a. Not more than 15 degrees from vertical:

1) Design glass for a probability of breakage not greater than 0.008 (8 lites per 1,000)

b. More than 15 degrees from vertical:

1) Design glass for a probability of breakage not greater than 0.001 (1 lite per 1,000).

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 the short side length or 1 inch, whichever is less.
4. Thermal Loads (Differential Shading): Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

G. Insulating Glass:

1. Insulating Glass Certification Program: Provide insulating glass units that are certified by the Insulating Glass Certification Council (IGCC).

a. Provide permanent markings with appropriate certification label of IGCC on either the spacer or one lite of each insulated unit.

H. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

1. Provide permanent markings on safety-rated glazing in compliance with applicable safety glazing standards, ICC (IBC), local building code and authorities having jurisdiction.
2. Glass indicated to be fully tempered (Kind FT) glass or laminated glass shall comply with safety glazing requirements.

2.3 FLOAT GLASS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

1. Glass Tints: Provide the following:

a. Color: Bronze.

1) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Solarbronze, or a comparable product from any of the manufacturers specified for float glass.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Float glass laminated with a polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.

a. Unless otherwise indicated:

1) Laminated glass shall consist of two plies of clear annealed float glass with a polyvinyl butyral interlayer.
2) Glass plies shall be of equal thicknesses.

2. Interlayer:

a. Material: Polyvinyl butyral.
b. Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

1) Minimum Thickness: 0.030 inch thick, unless otherwise indicated.

c. Color: Clear unless otherwise indicated.

3. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air pockets.

2.5 GLASS COATINGS

A. General: Float glass with one or more glass coatings.

B. Low-E-Coated Glass: Comply with ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on float glass; Kind CV (vision glass) and Kind CS (spandrel glass) as indicated.

1. Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Solarban 70, or a comparable product from any of the manufacturers specified for float glass.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of float glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

B. Perimeter Spacer: Warm-edge spacer.

1. General:

a. Material: Manufacturer's standard low conductivity silicone, polymer, stainless steel, or hybrid material.
b. Spacer Color: Black or Gray.
c. Spacer Width: As required for specified insulating glass unit.
d. Edge Seal: Duel-sealed system.

1) Primary Seal: Applied between spacer and glass panes.
2) Secondary Seal: Applied around perimeter of insulated unit.
3) Edge Seal Color: Black.

e. Use edge seal materials as recommended by spacer manufacturer and insulating glass manufacturer.

2. Products: Subject to compliance with requirements provide one of the following systems:

a. Quanex IG Systems, Inc; Super Spacer Premium Enhanced: www.quanex.com.

1) Spacer Material: Silicone foam with integral desiccant and vapor barrier backing.
2) Primary Seal: High performance acrylic adhesive.
3) Secondary Seal: Hot melt or curative butyl sealant.

b. Technoform Glass Insulation; TGI-Spacer M: www.glassinsulation.us.

1) Spacer Material: Polypropylene top with integral desiccant and stainless steel back.
2) Primary Seal: Butyl sealant.
3) Secondary Seal: Butyl sealant.

c. Viracon, Inc; Viracon Thermal Spacer (VTS): www.viracon.com.

1) Spacer Material: Thermoplastic with integral desiccant.
2) Primary Seal: Polyisobutylene (PIB) sealant.
3) Secondary Seal: Butyl sealant.

d. Vitro Architectural Glass (Formerly PPG); Intercept Spacer System: www.vitroglazings.com.

1) Spacer Material: Stainless steel.
2) Primary Seal: Polyisobutylene (PIB) sealant.
3) Secondary Seal: Butyl sealant.

C. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 SWITCHABLE PRIVACY GLASS

A. Products: Subject to compliance with requirements provide American Switch Glass; Switchable Privacy Glass: www.americanswitchglass.com, or a comparable product from one of the following:

1. Approved equal.

B. Laminated Glass with Switchable Privacy Film: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Unless otherwise indicated, switchable privacy glass shall consist of two plies of clear annealed float glass with 2 polyvinyl butyral interlayers sandwiching a switchable privacy film.

a. Glass Plies: Glass plies shall be of equal thicknesses; not less than that indicated and as needed to comply with requirements.

1) Minimum Thickness of Each Glass Ply: 1/4 inch (6mm) .

b. Polyvinyl Butyral (PVB) Interlayers:

1) Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

a) Minimum Thickness: 0.030 inch thick, unless otherwise indicated.

2) Color: Clear unless otherwise indicated.

c. Switchable Privacy Film: Switchable privacy film made of two layers of transparent conductive films sandwiching a polymer dispersed liquid crystal (PDLC) material. When electricity is applied (power is turned on) to the film the liquid crystals align and the window is clear. When the electricity is removed (power is turned off), the liquid crystals return to a scattered position and the window becomes translucent.

1) Switching Time: Approximately 100 milliseconds at room temperature.

d. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air pockets.

2. Wiring: Each laminated glass unit shall have internal wiring as standard with manufacturer and a wiring pigtail extending from one edge of the glass for connecting to remotely located low voltage power supply provided by switchable privacy glass manufacturer.

a. Each power supply shall power up to 60 sq. ft. of glass.
b. Electrical Requirements:

1) Voltage: 120 volt; 65 plus or minus 5 volts AC.
2) Current: Less than 20 mA per sq ft..
3) Power: Less than 0.5 watt per sq ft.

c. Provide all associated wiring and related components for connecting glass to the power supplies.
d. Coordinate with Division 26 for power and controls.

1) Division 26 shall provide power to the power supplies.
2) Division 26 shall provide controls (switch).

3. Performance:

a. Haze: Approximately 7 percent.
b. Visible Light Transmission (VLT): Approximately 75 percent.
c. View Angle: Approximately 150 degrees.
d. Solar Heat Gain Coefficient (SHGC):

1) In Off State: Less than 0.10.
2) In On State: 0.40 to 0.60.

e. Infrared:

1) In On State: 1 percent.
2) In On State: 50 percent.

2.8 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. General Glazing Silicone Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25 or 50, Use NT.

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

a. Dow Corning Corporation; 795 Silicone Building Sealant: www.dowcorning.com.
b. Dow Corning Corporation; 899 Silicone Glazing Sealant: www.dowcorning.com.
c. GE/Momentive Performance Materials, Inc: SCS2800 SilGlaz II: www.siliconeforbuilding.com
d. Pecora Corporation: 896: www.pecora.com.
e. Tremco, Inc.: Spectrem 2: www.tremcosealants.com.

2. Color: Black, except as follows:

a. Color at Glass Butt Joints: Clear.

2.9 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM, silicone, or neoprene with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. EPDM, silicone, or neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated, but not less than 50 to 60 Shore A durometer hardness.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM, silicone, or neoprene with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

F. Glazing Gaskets and Splines: Resilient EPDM or polyvinyl chloride extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black

G. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.11 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

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

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Glazing:

1. Exterior Glass: Unless otherwise indicated, exterior glass shall be insulating-glass units.

a. Provide glass tints as indicated.
b. Provide Low-E-coating unless otherwise indicated.
c. Provide safety glass where indicated and as required by local building code and authorities having jurisdiction.

2. Interior Glass: Unless otherwise indicated, all interior glass shall be monolithic glass units.

   a. Provide safety glass where indicated and as required by local building code and authorities having jurisdiction.

3. Exterior doors at vestibule entrances shall have Low-E-coated insulating-glass units safety glass; interior vestibule doors shall have monolithic safety glass.

   a. Insulating glass shall comply with exterior glass above.
   b. Monolithic safety glass shall comply with interior glass above.

B. Installation Method:

   1. Use one or more of the specified glazing methods as recommended by GANA, glass manufacturer, fabricator, and installer, and as required to comply with performance requirements.

C. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. Provide spacers for glass lites where length plus width is larger than 50 inches.

   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

J. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

K. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

L. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

M. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant as recommended by GANA.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape as recommended by GANA..

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 INSTALLATION OF SWITCHABLE PRIVACY GLASS

A. Install switchable privacy glass in accordance with manufacturer's instructions.

B. Installation Method:

1. Use one or more of the specified glazing methods as recommended by switchable glass manufacturer, fabricator, and installer, and as required to comply with performance requirements.

C. Wiring: Low voltage wiring and power supplies shall be provided by this section.

1. Route low voltage wiring thru framing members of glass framing system.

a. Coordinate with Section 08 1116 – Aluminum Doors and Frames.

2. Coordinate with Division 26 for power and controls.

a. Division 26 shall provide power to the power supplies.
b. Division 26 shall provide controls (switch).

3.8 INSTALLATION OF CURVED/RADIUS GLASS

A. Install curved glass where indicated on Drawings.

1. Reuse existing u-shaped base channel at floor.
2. Capture glass in new wood millwork at soffit head detail as indicated on Drawings.

B. Installation Method:

1. Use one or more of the specified glazing methods as recommended by glass manufacturer, fabricator, and installer, and as required to comply with performance requirements.

C. Butt Joints: Seal vertical butt joints between glass lites with sealant.

1. Install butt-joint sealants according to manufacturer's instructions to produce a smoke-tight installation.

3.9 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.10 GLAZING SCHEDULE

A. GL-1: Clear monolithic glass.

1. Clear annealed float glass.
2. Minimum Thickness: 1/4 inch (6 mm).

B. GL-2: Clear monolithic safety glass.

1. Clear laminated safety glass.
2. Minimum Overall Thickness: 1/4 inch (6 mm).
3. Safety glazing required.

C. GL-3: Clear monolithic safety glass, curved.

1. Clear tempered safety glass.
2. Minimum Overall Thickness: 1/2 inch (12 mm).
3. Safety glazing required.
4. Radius: 16 foot radius; unless otherwise indicated on Drawings; field verify.

D. GL-4: Switchable privacy glass.

1. Clear laminated switchable privacy glass.
2. Minimum Overall Thickness: 9/16 inch.
3. Safety glazing required.

E. GL-5: Low-E-coated, tinted insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Outdoor Lite: Tinted annealed float glass.

    a. Minimum Thickness: 1/4 inch (6 mm).
    b. Tint Color: Bronze.

3. Airspace:

    a. Width: 1/2 inch.
    b. Interspace Content: Air.

4. Indoor Lite: Clear annealed float glass.

    a. Minimum Thickness: 1/4 inch (6 mm).
    b. Low-E Coating: On 3rd surface.

5. Performance:

    a. Winter Nighttime U-Factor: 0.29 maximum.
    b. Visible Light Transmittance: 42 percent minimum.
    c. Solar Heat Gain Coefficient: 0.32 maximum.

F. GL-6: Low-E-coated, tinted, insulating safety glass

1. Overall Unit Thickness: 1 inch.
2. Outdoor Lite: Tinted laminated float glass.

   a. Minimum Overall Thickness: 1/4 inch (6 mm).
   b. Tint Color: Bronze.

3. Airspace:

   a. Width: 1/2 inch.
   b. Interspace Content: Air.

4. Indoor Lite: Clear laminated float glass.

   a. Minimum Overall Thickness: 1/4 inch (6 mm).
   b. Low-E Coating: On 3rd surface.

5. Safety glazing required.
6. Performance:

   a. Winter Nighttime U-Factor: 0.29 maximum.
   b. Visible Light Transmittance: 42 percent minimum.
   c. Solar Heat Gain Coefficient: 0.32 maximum.

END OF SECTION 08 8000

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Non-load-bearing steel framing systems for interior partitions, ceilings, and soffits.
2. Suspension systems for interior ceilings and soffits.
3. Shaft wall framing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Indicate component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories and items of other related work.
2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Qualification Statement.

B. Installer's Qualification Statement.

C. Evaluation Reports: For firestop tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. ClarkDietrich Building Systems: www.clarkdietrich.com.
2. Jaimes Industries Inc.: www.jaimesind.com.
3. Marino\WARE: www.marinoware.com.
4. MBA Building Supplies, Inc.: www.mbastuds.com.
5. State Building Products; www.statebp.com.
6. The Steel Network, Inc: www.SteelNetwork.com.

7. Telling Industries; www.buildstrong.com.

2.2 PERFORMANCE REQUIREMENTS

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Protective Coatings: Equivalent (EQ) coatings are not acceptable; products shall be hot-dip galvanized as indicated.

C. Embossed (equivalent thickness) steel framing products are not acceptable; products shall be in steel thicknesses indicated.

D. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

E. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

F. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

1. Exception: Limit deflection of walls to receive hard tile surfaces to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft.

G. Shaft Wall Framing:

1. Comply with requirements of Fire-Rated Assemblies.
2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics, unless otherwise indicated on Drawings:

   a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
   b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

3. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics; unless otherwise indicated on Drawings:

   a. Air Pressure Within Shaft: Intermittent loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
   b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

2.3 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
2. Protective Coating: ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C645.

1. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: 0.0329 inch (20 gage).
b. Depth: As indicated on Drawings.

C. Slotted Deflection Track: Provide galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings.

1. Comply with the following:

a. Provide at partition heads to structure connections, where indicated on Drawings, and elsewhere as required to accommodate axial deflection.
b. Shall prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above
c. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
d. Comply with ASTM C645 and ASTM C754.
e. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
f. Minimum Metal Thickness: Same material thickness as studs.
g. Track Depth: Matching studs.
h. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.

D. At Contractor's option, the following products may be used instead of traditional framing and firestopping:

1. General: Provide components UL-listed for use in head of partitions and joint systems and as indicated on drawings.
2. Slotted Deflection and Firestop Track: Galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings. Includes intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

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

1) ClarkDietrich Building Systems; BlazeFrame (DSL 2): www.clarkdietrich.com.
2) Marino\WARE; FAS Track 1000: www.marinoware.com.

3. Firestop Track: Galvanized sheet steel track with intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.

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

1) ClarkDietrich Building Systems; BlazeFrame (DL2): www.clarkdietrich.com.

4. Preformed Top Track Firestop Seal: Pre-formed firestop device field-applied to head of top track that expands when exposed to heat or flames to provide a perimeter joint seal.

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

1) Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com.

E. Curved Track: ASTM C645. Flexible framing track for curves, bends, and variable radii.

1. Minimum Base-Steel Thickness: 0.0329 inch (20 gage).
2. Depth: As indicated on Drawings.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ClarkDietrich Building Systems; 360TRAK: www.clarkdietrich.com.

F. Cold-Rolled Channel Bridging: 0.064 inch thick (16 gage), galvanized minimum base-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- (16 gage) thick, galvanized steel.

G. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.064 inch thick (16 gage), galvanized.

H. At Contractor's option, the following products may be used instead of traditional flat strap and backing plates:

1. Flexible Wood Backing: Fire-retardant treated wood with sheet steel connectors.

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

1) ClarkDietrich Building Systems; Danback Flexible Wood Backing System: www.clarkdietrich.com.

2.4 SHAFT WALL FRAMING

A. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 (Z120) unless otherwise indicated.

B. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Profile: Manufacturer's standard C-H or C-T profile.
2. Depth: As indicated.
3. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).

C. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs.

D. Slotted Deflection Track: As specified in Framing Systems, above, including Contractor’s options for firestop tracks.

2.5 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.

a. Uses: Securing hangers to structure.
b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
c. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (16 gage) and minimum 1/2-inch-wide flanges.
1. Depth: 2 inches, unless otherwise indicated on Drawings.

E. Furring Channels (Furring Members):

1. Hat-Shaped, Rigid Furring Channels: ASTM C645; galvanized steel sheet members.

a. Minimum Base-Steel Thickness: 0.0329 inch (20 gage).
b. Depth: 7/8 inch, unless otherwise indicated on Drawings.

2. Resilient Furring Channels: ASTM C645; 1/2-inch-deep, galvanized steel sheet members designed to reduce sound transmission.

a. Minimum Base-Steel Thickness: 0.0179 inch (25 gage).
b. Configuration: Asymmetrical.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. At Contractor's option provide grid suspension system instead of traditional carrying and furring channels.
2. Not permitted for multi-layer gypsum board systems.
3. Manufacturers: Subject to compliance with requirements, provide one of the following products:

a. Armstrong World Industries, Inc.; Drywall Grid Suspension System: www.armstrongceilings.com.
b. CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: www.certainteed.com.
c. Rockfon, Part of the Rockwool Group; Chicago Metallic Drywall Grid: www.rockfon.com.
d. USG Corporation: Drywall Suspension System: www.usg.com

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

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

1) Williams; Everlastic EVA 200; www.williamsproducts.net.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing, suspension systems and other related accessories and components in accordance with manufacturer’s instructions.

C. Install shaft wall framing to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

1. At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration.

D. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

E. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

F. Install bracing at terminations in assemblies.

G. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Install studs at 16 inches o.c. unless otherwise indicated or required by horizontal deflection performance requirements.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slotted Deflection Tracks: Where framing extends to overhead structural supports, install slotted deflection tracks to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 2100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Lateral/Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 2116

SECTION 09 2400 – CEMENT PLASTERING

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. Cement plastering.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Initial Selection: For each color and texture specified.

D. Samples for Verification: For each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each substrate and finish texture indicated for cement plastering, including accessories.

   a. Size: 100 sq. ft. in surface area.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.8 FIELD CONDITIONS

A. Comply with ASTM C926 requirements.

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F.
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

C. Interior Plasterwork: Maintain room temperatures at greater than 40 deg F for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

PART 2 - PRODUCTS

2.1 METAL LATH

A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653, G60, hot-dip galvanized-zinc coating.

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

a. ClarkDietrich Building Systems: www.clarkdietrich.com.
b. Marino\WARE: www.marinoware.com.
c. Phillips Manufacturing Co: www.phillipsmfg.com.

2. Flat-Rib Lath: Rib depth of not more than 1/8 inch, 3.4 lb/sq. yd..

2.2 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

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

a. ClarkDietrich Building Systems: www.clarkdietrich.com.
b. Marino\WARE: www.marinoware.com.
c. Phillips Manufacturing Co: www.phillipsmfg.com.

2. Fabricated from hot-dip galvanized-steel sheet, ASTM A653, G60 zinc coating

3. Profiles and Shapes:

a. Cornerbeads: Fabricated from zinc.

1) Smallnose cornerbead with expanded flanges; use unless otherwise indicated.

b. Casing Beads: Fabricated from zinc; square-edged style; with expanded flanges.
c. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
d. Expansion Joints: Fabricated from zinc; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products from one of the following

a. Fry Reglet Corp.; www.fryreglet.com.
b. Gordon, Inc.; www.gordon-inc.com.
c. Pittcon Industries; www.pittconindustries.com.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
3. Shapes and Profiles: As indicated on Drawings, including, but not limited to, the following:

a. Vented F-Reveals: Equal to Fry Reglet Model FPM-75-V-75.

1) Reveal Size: 3/4 inch wide by 3/4 inch deep

b. Vented Plaster Key Reveals: Equal to Fry Reglet Model PRZ-75-V-75.

1) Reveal Size: 7/8 inch wide by 3/4 inch deep

c. Vented Channel Reveals: Equal to Fry Reglet PCS-75-V-75.

1) Reveal Size: 3/4 inch wide by 3/4 inch deep

4. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.3 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

C. Wire: ASTM A641, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

2.4 PLASTER MATERIALS

A. Portland Cement: ASTM C150, Type I.

1. Color for Finish Coats: White.

B. Lime: ASTM C206, Type S; or ASTM C207, Type S.

C. Sand Aggregate: ASTM C897.

D. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample.

2.5 PLASTER MIXES

A. General: Comply with ASTM C926 for applications indicated.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.

a. Include colorants in proportions in accordance with manufacturer’s instructions for color specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

3.3 INSTALLING METAL LATH

A. Metal Lath: Install according to ASTM C1063.

1. Install flat- flat-rib lath.

3.4 INSTALLING ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install cornerbead at exterior locations.
2. Install cornerbead at interior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

   a. Vertical Surfaces: 144 sq. ft.
   b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft.

2. At distances between control joints of not greater than 18 feet o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

D. Aluminum Trim: Install in locations indicated on Drawings and as follows:

1. Use longest practical lengths.

3.5 PLASTER APPLICATION

A. General: Comply with ASTM C926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 3/4-inch total thickness, as follows:

1. Portland cement mixes.

C. Plaster Finish Coats: Apply to provide finish to match Architect's sample.

3.6 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09 2400

SECTION 09 2900 – GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Gypsum board.
2. Shaft wall liner panels.
3. Tile backing panels.
4. Finishing materials.
5. Trim accessories.
6. Acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

1. Include locations of control joints.

C. Samples: For the following products:

1. Submit three samples of each board type, 4 inches square in size
2. Trim Accessories: Submit three samples of each type of trim, full-size in 4-inch-long lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Qualification Statement.

B. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

C. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install interior gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

D. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

1. Exception: Limit deflection of walls to receive hard tile surfaces to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft.

E. Shaft Wall Completed Assemblies:

1. Comply with requirements of Fire-Rated Assemblies.
2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics, unless otherwise indicated on Drawings:

a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

3. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics; unless otherwise indicated on Drawings:

a. Air Pressure Within Shaft: Intermittent loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.

b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 GYPSUM BOARD

A. Gypsum Wallboard: Paper-faced gypsum panels; ASTM C1396/C1396M.

1. Thickness: 1/4 and 1/2 inch.
2. Long Edges: Tapered with paper face wrapping edge.
3. Short Edges: Square cut.
4. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Regular Gypsum Board: www.certainteed.com.
b. Continental Building Products; Regular Drywall: www.continental-bp.com.
c. Georgia-Pacific Gypsum; ToughRock Gypsum Board: www.gp.com.
d. National Gypsum Company; Gold Bond Brand Gypsum Board: www.nationalgypsum.com.
e. USG Corporation; Sheetrock Brand Gypsum Panels: www.usg.com.

B. Gypsum Board, Type X: Paper-faced gypsum panels with fire-resistant core; ASTM C1396/C1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered with paper face wrapping edge.
3. Short Edges: Square cut.
4. Type: Fire resistance rated Type X, UL or WH listed.
5. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Type X Gypsum Board: www.certainteed.com.
b. Continental Building Products; Firecheck Type X: www.continental-bp.com.
c. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gp.com.
d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: www.nationalgypsum.com.
e. USG Corporation; Sheetrock Brand Firecode X Panels: www.usg.com.

2.4 SHAFT WALL LINER PANELS

A. Gypsum Shaft Wall Liner Panels: Paper-faced gypsum liner panels with fire-resistant core; ASTM C1396/C1396M.

1. Thickness: 1 inch.
2. Width: 24 inches.
3. Long Edges: Double beveled with paper face wrapping edge.
4. Short Edges: Square cut.
5. Type: Fire resistance rated Type X, UL or WH listed.
6. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; M2Tech Shaftliner Type X Gypsum Board: www.certainteed.com.
b. Continental Building Products; Shaftliner Type X with Mold Defense: www.continental-bp.com.
c. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gp.com.
d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner: www.nationalgypsum.com.
e. USG Corporation; Sheetrock Brand Gypsum Liner Panels: www.usg.com.

2.5 TILE BACKING PANELS

A. Cementitious Backing Panel: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Thickness: 5/8 inch.
2. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:

   a. Showers.

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

   a. National Gypsum Company; PermaBase Brand Cement Board: www.nationalgypsum.com.
   b. USG Corporation; Durock Brand Cement Board: www.usg.com.

B. Glass-Mat Backing Panel: Coated glass mat water-resistant gypsum backing panel; ASTM C1178/C1178M.

1. Thickness: 5/8 inch.
2. Type: Fire resistance rated Type X, UL or WH listed.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Non-wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:

   a. Toilet rooms.

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

   a. CertainTeed Corp.; GlasRoc Diamondback Tile Backer: www.certainteed.com.
   b. Continental Building Products; Or Equal: www.continental-bp.com.
   c. Georgia-Pacific Gypsum; DensShield Tile Backer: www.gp.com.
   d. National Gypsum Company; Gold Bond Brand eXP Tile Backer: www.nationalgypsum.com.
   e. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or paper-faced galvanized-steel sheet.
2. Shapes:

   a. Cornerbead.
   b. LC-Bead (J-shaped) or L-Bead (L-shaped) at exposed edges.
   c. Expansion (control) joint.
   d. Curved-Edge Cornerbead: With notched or flexible flanges.

3. Manufacturers: Subject to compliance with requirements, available manufacturers with products that may be incorporated into the Work include, but are not limited to, the following:

   a. ClarkDietrich Building Systems: www.clarkdietrich.com.
   b. Marino\WARE: www.marinoware.com.
   c. Telling Industries; www.buildstrong.com.
   d. Phillips Manufacturing Co: www.phillipsmfg.com.
   e. USG Corporation: www.usg.com.

4. At Contractor's option, the following products may be used instead of traditional interior trim.

   a. Interior Trim: Impact-resistant composite corner bead consisting of copolymer core, joint tape and surface paper.

      1) Shapes:

         a) Cornerbead; inside and outside corners.
         b) L-Trim.

      2) Products: Subject to compliance with requirements, provide one of the following:

         a) Structus Building Technologies, Inc.; No-Coat Structural Laminate Drywall Corner System; www.no-coat.com
         b) CertainTeed Corp.; No-Coat Drywall Corner: www.certainteed.com

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape: Paper, 2 inches wide, creased for joints and corners.

   1. Exception: At tile backing panels use fiberglass tape; coated 10-by-10 glass mesh.
   2. Manufacturers: Subject to compliance with requirements, provide products from one of the specified gypsum wall board manufacturers.

C. Joint Compound: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

   1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.

      a. Use setting-type compound for installing paper-faced metal trim accessories.

   3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

   1. Glass-Mat Backing Panel: As recommended by backing panel manufacturer.
   2. Cementitious Backing Panel: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

   1. Joint Compound: As recommended by gypsum board manufacturer.
   2. Adhesives: Subject to compliance with requirements, provide one of the following

      a. Franklin International, Inc; Titebond GREENchoice Professional Drywall Adhesive; www.titebond.com.
      b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive: www.liquidnails.com.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members (cold-formed metal framing) from 0.033 to 0.112 inch thick.
2. For fastening cementitious backing panels, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: Produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Acoustic Insulation:

a. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.

1) Thickness: 3 inches, unless otherwise indicated.
2) Density: 2.5 pcf.
3) Flame Spread/Smoke Developed: 0/0 per ASTM E84.
4) Products: Subject to compliance with requirements, provide one of the following:

a) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.
b) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
c) Rockwool; Safe’n’Sound: www.rockwool.com.

E. Acoustical Sealant: As specified in Section 07 9200 – Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840, GA-216, and manufacturer's instructions.

B. Install shaft wall liner panels to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

1. At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly.

C. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Form control and expansion joints with space between edges of adjoining gypsum panels.

G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft.in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat Backing Panels: Comply with manufacturer's written installation instructions. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: Comply with ANSI A108.11.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect. Place control joints consistent with lines of building spaces and as follows:

1. Not more than 30 feet apart on walls and ceilings, unless otherwise indicated.
2. Submit control joint locations to Architect for approval prior to installation.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead or L-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

   a. Exception: Fire-Rated Construction shall comply with requirements of assembly listing

2. Level 2: In utility areas, behind cabinetry, and in similar locations that shall not be painted or finished, and at tile backing board to receive tile finish.
3. Level 4: At areas that will be exposed to view; unless otherwise indicated.

E. Glass-Mat Backing Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backing Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.8 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:

a. Installation of 80 percent of lighting fixtures, powered for operation.
b. Installation, insulation, and leak and pressure testing of water piping systems.
c. Installation of air-duct systems.
d. Installation of air devices.
e. Installation of mechanical system control wiring.
f. Installation of ceiling support framing.

END OF SECTION 09 2900

SECTION 09 3000 – TILING

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. Hard tile.
2. Stone thresholds.
3. Setting materials.
4. Waterproofing and crack isolation membranes.
5. Metal trim.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

1. Include:

a. TCNA installation methods.
b. Locations of waterproofing and crack isolation membranes.
c. Locations and profiles of metal trim.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Thresholds in 6-inch lengths for each profile, color and finish required.
4. Metal trim in 6-inch lengths for each profile, color and finish required.

E. Product Schedule: For tile. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of product.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 2 percent of amount installed for each type, composition, color, pattern, and size indicated but not less than 1 box.
2. Grout: Furnish quantity of grout equal to 2 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience, and as follows:

1. Installer employs only Ceramic Tile Education Foundation Certified Installers
2. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors, membranes, shower receptors, and large format tile.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Mockup sizes shall be sized as appropriate to demonstrate complete tile pattern layout; 16 square feet, minimum
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials from single manufacturer.
2. Obtain waterproofing and crack isolation membrane from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Thresholds.
2. Metal edge strips.

2.2 PERFORMANCE REQUIREMENTS

A. Floor tile and other traffic surfaces:

1. Dynamic Coefficient of Friction: Not less than 0.42 when tested in accordance with DCOF AcuTest per ANSI A137.1.

2.3 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation methods, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.4 TILE PRODUCTS

A. Ceramic Floor Tile - FT-01:

1. Product: Subject to compliance with requirements, provide the following:

   a. Ergon/Emilgroup; Stone Project: www.emilgroup.com.
   b. No substitutions.

2. Size: 11-13/16 by 23-5/8 inches.
3. Thickness: 3/8 inch.
4. Tile Color, Glaze, and Pattern: As indicated in Color Codes on Drawings.
5. Grout Color: As indicated by Room Finish Schedules and Color Codes on Drawings.
6. Joint Size: As recommended by tile manufacturer.

B. Ceramic Floor Tile - FT-02, FT-03, FT-04:

1. Product: Subject to compliance with requirements, provide the following:

   a. Caesar Ceramics USA; Join: www.emilgroup.com.
   b. No substitutions.

2. Size: 11-13/16 by 23-5/8 inches.
3. Thickness: 3/8 inch.
4. Tile Color, Glaze, and Pattern:

   a. FT-02: As indicated in Color Codes on Drawings.
   b. FT-03: As indicated in Color Codes on Drawings.
   c. FT-04: As indicated in Color Codes on Drawings.

5. Grout Color:

   a. FT-02: As indicated by Room Finish Schedules and Color Codes on Drawings.
   b. FT-03 As indicated by Room Finish Schedules and Color Codes on Drawings.
   c. FT-04: As indicated by Room Finish Schedules and Color Codes on Drawings.

6. Joint Size: As recommended by tile manufacturer.

C. Ceramic Wall Tile - WT-01:

1. Product: Subject to compliance with requirements, provide the following:

   a. Ergon/Emilgroup; Stone Project: www.emilgroup.com.
   b. No substitutions.

2. Size: 11-13/16 by 23-5/8 inches.
3. Thickness: 3/8 inch.
4. Tile Color, Glaze, and Pattern: As indicated in Color Codes on Drawings.
5. Grout Color: As indicated by Room Finish Schedules and Color Codes on Drawings.
6. Joint Size: As recommended by tile manufacturer.

D. Ceramic Wall Tile - WT-02, WT-04, WT-05, WT-06:

1. Product: Subject to compliance with requirements, provide the following:

   a. Caesar Ceramics USA; Join: www.emilgroup.com.

b. No substitutions.

2. Size:

a. WT-02: 11-13/16 by 23-5/8 inches.
b. WT-04 4-5/8 by 23-5/8 inches.
c. WT-05: 3 by 23-5/8 inches, bullnose.
d. WT-06: 4-5/8 by 23-5/8 inches.

3. Thickness: 3/8 inch.
4. Tile Color, Glaze, and Pattern:

a. WT-02: As indicated in Color Codes on Drawings.
b. WT-04 As indicated in Color Codes on Drawings.
c. WT-05: As indicated in Color Codes on Drawings.
d. WT-06: As indicated in Color Codes on Drawings.

5. Grout Color:

a. WT-02: As indicated by Room Finish Schedules and Color Codes on Drawings.
b. WT-04 As indicated by Room Finish Schedules and Color Codes on Drawings.
c. WT-05: As indicated by Room Finish Schedules and Color Codes on Drawings.
d. WT-06: As indicated by Room Finish Schedules and Color Codes on Drawings.

6. Joint Size: As recommended by tile manufacturer.

E. Ceramic Wall Tile - WT-03:

1. Product: Subject to compliance with requirements, provide the following:

a. Marazzi; Zellige: www.marazziusa.com.
b. No substitutions.

2. Size: 3-15/16 by 3-15/16 inches.
3. Thickness: 3/8 inch.
4. Tile Color, Glaze, and Pattern: As indicated in Color Codes on Drawings.
5. Grout Color: As indicated by Room Finish Schedules and Color Codes on Drawings.
6. Joint Size: As recommended by tile manufacturer.

2.5 TILE TRIM UNITS

A. Tile Trim Units: Except as otherwise specified, provide trim units from same manufacturer, product line, color and finish, as each specified tile; and as follows:

1. Shapes: As selected by Architect from manufacturer's standard shapes; coordinate with adjacent tile sizes and jointing

a. Shapes include, but are not limited to, the following:

1) Bullnose units.
2) Cove base units.

2. Sizes: As selected by Architect from manufacturer's standard sizes; coordinate with adjacent tile sizes and jointing

B. Tile Base – B-05:

1. Product: Subject to compliance with requirements, provide the following:

   a. Ergon/Emilgroup; Stone Project: www.emilgroup.com.
   b. No substitutions.

2. Size: 3 by 24 inches, bullnose.
3. Thickness: 3/8 inch.
4. Tile Color, Glaze, and Pattern: As indicated in Color Codes on Drawings.
5. Grout Color: As indicated by Room Finish Schedules and Color Codes on Drawings.
6. Joint Size: As recommended by tile manufacturer.

2.6 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface.

   a. Finish bevel to match top surface of threshold.

2. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Threshold:

1. Comply with ASTM C503.
2. Abrasion Resistance: 12, minimum according to ASTM C1353 or ASTM C241 and with honed finish.
3. Description: Uniform, fine- to medium-grained gray stone with white veining.

2.7 SETTING MATERIALS

A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

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

   a. Bostik, Inc; Bostik PM: www.bostik.com.
   b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar: www.custombuildingproducts.com.
   c. LATICRETE International, Inc; 253 Gold: www.laticrete.com.
   d. MAPEI Corp.; Ultraflex 2: www.mapei.com.
   e. TEC, H.B. Fuller Construction Products Inc.; Full Flex Premium Thin Set Mortar: www.tecspecialty.com.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Large Format Tile, Modified Dry-Set Mortar (Medium-Bed): Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of up to 3/4 inch.

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

a. Bostik, Inc; Big Tile & Stone: www.bostik.com.
b. Custom Building Products; Natural Stone & Large Tile Premium Mortar: www.custombuildingproducts.com.
c. LATICRETE International, Inc; 4-XLT: www.laticrete.com.
d. MAPEI Corp.; Large Tile & Stone Mortar: www.mapei.com.
e. TEC, H.B. Fuller Construction Products Inc; Ultimate Large Tile Mortar or Ultraflex LFT: www.tecspecialty.com.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

C. Mortar Bed Materials (Thick-Bed): ANSI A108.02

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

a. Bostik, Inc; Mud-In-A-Bag with 425 Multi-Purpose Acrylic Latex Admixture: www.bostik.com.
b. Custom Building Products; Thick Bed Bedding Mortar with Thin-Set & Mortar Admix: www.custombuildingproducts.com.
c. LATICRETE International, Inc; 3701 Fortified Mortar: www.laticrete.com.
d. MAPEI Corp.; Modified Mortar Bed: www.mapei.com.
e. TEC, H.B. Fuller Construction Products Inc.; Floor Mud with Acrylond AMA Acrylic Mortar Additive: www.tecspecialty.com.

2. Provide prepackaged, dry-mortar mix that either contains a dry, redispersible, vinyl acetate or acrylic additive or has a separately packaged liquid-latex additive. only water must be added at Project site after mixing prepackaged ingredients.

3. At Contractor's option a field mixed mortar bed may be used instead of the specified prepackaged materials. Comply with ANSI A108.1a and the following:

a. Mortar mix to include Portland cement, sand, and hydrated lime, and water in ratios complying with ANSI A108.1a, Article 2.2

4. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A185 and ASTM A82, except for minimum wire size.

2.8 GROUT MATERIALS

A. High-Performance Grout: ANSI A118.7.

1. Drawing Designations: GR-01, GR-02, GR-03, GR-04.
2. Grout Colors: As indicated in Color Codes on Drawings.
3. Products:

a. Pre-mixed Single-component Grout: High performance formulation; stain resistant, no sealer required. Subject to compliance with requirements, provide one of the following:

1) Bostik, Inc; TruColor RapidCure: www.bostik.com.

2) Custom Building Products; Fusion Pro Single Grout: www.custombuildingproducts.com.
3) LATICRETE International, Inc; Ready-To_use Grout: www.laticrete.com.
4) MAPEI Corp.; Flexcolor CQ: www.mapei.com.
5) TEC, H.B. Fuller Construction Products Inc; InColor Advanced Performance Grout: www.tecspecialty.com.

2.9 WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. Waterproofing and Crack Isolation Membrane: ANSI A118.10 and ANSI A118.12.

1. System consisting of liquid-latex rubber or elastomeric polymer; with or without fabric reinforcement
2. Thickness: As recommended by membrane manufacturer.
3. Crack Resistance: No failure at 1/8 inch gap, minimum.

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

1. Without Fabric Reinforcing:

a. Custom Building Products; RedGard: www.custombuildingproducts.com.
b. LATICRETE International, Inc; Hydro Ban: www.laticrete.com.
c. MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.

2. With Fabric Reinforcing:

a. Bostik, Inc; GoldPlus: www.bostik.com.
b. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane: www.custombuildingproducts.com.
c. LATICRETE International, Inc; Hydro Barrier: www.laticrete.com.
d. MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
e. TEC, H.B. Fuller Construction Products Inc; HydraFlex: www.tecspecialty.com.

2.10 METAL TRIM

A. Metal Trim: Except as otherwise indicated provide the following:

1. Metallic edge trim, height to match tile and setting-bed thickness, designed specifically for tiling applications; stainless steel, ASTM A276 or ASTM A666, 300 Series exposed-edge material.

a. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1) Schluter-Systems: www.schluter.com.
2) Or approved equal.

b. Profiles:

1) Angle or L-shaped.

a) Equal to Schluter-Systems; Schiene: www.schluter.com

2) Squared reveal-shaped.

a) Equal to Schluter-Systems; Quadec: www.schluter.com

3) Cove-shaped.

a) Equal to Schluter-Systems; Dilex-AHK: www.schluter.com

4) Other shapes as indicated on Drawings.

c. Finish: Brushed stainless steel.
d. Provide associated corner pieces, if any.
e. Applications and Locations: Unless otherwise indicated or finished with tile trim units, provide metal trim at the following locations:

1) Open edges of wall tile.
2) Open edges of floor tile.
3) Outside wall corners.
4) Transitions between hard tile and other floor finishes.
5) Tile perimeters not against a wall or other solid vertical surface.
6) Other areas as indicated on Drawings.

2.11 MISCELLANEOUS MATERIALS

A. Shelf:

1. Description: Corner shelf designed for tile walls; with slotted cut-outs for water drainage.
2. Mounting: Surface mounted and integrated into tilework.
3. Material: Aluminum.
4. Finish: As selected by Architect.
5. Size: Trapazoidal; 12 inches wide with a 6 inch side and 2-1/2 inch side, nominal.
6. Product: Subject to compliance with requirements, provide Schluter-Systems; Shelf-E: www.schluter.com, or a comparable product from one of the following:

a. Or approved equal.

B. Joint Sealants

1. Tile Sealants - Traffic Grade:

a. Refer to Section 07 9200 - Joint Sealants.

1) Provide Nonsag traffic grade silicone sealant.

2. Tile Sealant - Non-traffic Grade: Gunnable siliconized acrylic; moisture and mildew resistant type.

a. Colors: To match adjacent grout colors.
b. Products: Subject to compliance with requirements, provide one of the following:

1) Bostik, Inc; Bosti-Flex Plus: www.bostik.com.
2) Custom Building Products; Polyblend Ceramic Tile Caulk: www.custombuildingproducts.com.
3) LATICRETE International, Inc; Premium Acrylic Caulk: www.laticrete.com.
4) MAPEI Corp.; Keracaulk S (sanded) and Keracaulk U (unsanded): www.mapei.com.
5) TEC, H.B. Fuller Construction Products Inc; AccuColor Sanded/Unsanded Siliconized Acrylic Caulk: www.tecspecialty.com.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Trowelable Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

2.12 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

   a. Flatness tolerances shall also comply with requirements of specified TCNA installation methods.

2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation methods.

B. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in specified TCNA installation methods.

C. Tile shall have 80 percent mortar coverage except as follows:

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

a. Exterior tile floors.
b. Tile floors in wet areas.
c. Tile swimming pool decks.
d. Tile floors in laundries.
e. Tile floors consisting of tiles 8 by 8 inches or larger.
f. Tile floors consisting of rib-backed tiles.

D. Bond Coats:

1. Use latex-portland cement thin-set mortar, unless otherwise indicated.

a. Exceptions:

1) For tiles that have at least one side greater than 15 inches long, use large format tile latex-portland cement medium-bed mortar.

b. Bond Coat Color: White or gray.

E. Grout:

1. Use high performance grout.

F. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

G. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

H. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges except where metal trim is indicated.

I. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

J. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

K. Joint Widths: Install tiles with joint widths indicated, if not indicated install in widths as directed by Architect in writing.

L. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

M. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

N. Thresholds: Install thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

O. Metal Edge Strips: Install in same type of setting bed as adjacent tile unless otherwise indicated.

3.4 INSTALLATION OF WATERPROOF MEMBRANE

A. Install waterproofing and crack isolation membrane to comply with ANSI A108.13, ANSI A108.17 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing and crack isolation membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Locations: Install waterproofing and crack isolation membrane at the following locations:

1. All floor and traffic areas.
2. Shower walls and floors.
3. Other areas as indicated on Drawings.

3.5 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR FLOOR TILE - INSTALLATION METHODS

A. Interior Floor Tile Installations:

1. Concrete Substrates - Thinset Installation: Install in accordance with TCNA F122 or F122A as appropriate for substrate conditions.

   a. Provide waterproofing and crack isolation membrane.
   b. Bond Coat: Modified dry-set mortar or medium-bed, modified dry-set mortar as appropriate to tile.
   c. Grout: High-performance grout.

2. Concrete Substrates - Bonded Mortar Bed Installation: Install in accordance with TCNA F112.

   a. Provide waterproofing and crack isolation membrane.
   b. Bond Coat: Modified dry-set mortar or medium-bed modified dry-set mortar as appropriate to tile.
   c. Grout: High-performance grout.

B. Interior Floor Tile Installations at Shower Pans:

1. Concrete Shower Substrates - Bonded Mortar Bed Installation: Install in accordance with TCNA B415 or B421 as appropriate for wall construction.

   a. Provide waterproofing and crack isolation membrane.
   b. Bond Coat: Modified dry-set mortar or medium-bed modified dry-set mortar as appropriate to tile.
   c. Grout: High-performance grout.

3.8 INTERIOR WALL TILE - INSTALLATION METHODS

A. Interior Wall Tile Installations:

1. Cementitious Backing Panel Substrates - Thinset Installation: Install in accordance with TCNA W244C.

   a. Provide waterproofing and crack isolation membrane at specified locations and as indicated on Drawings.
   b. Bond Coat: Modified dry-set mortar or medium-bed modified dry-set mortar as appropriate to tile.
   c. Grout: High-performance grout.

2. Glass-Mat Backing Panel Substrates - Thinset Installation: Install in accordance with TCNA W245.

   a. Provide waterproofing and crack isolation membrane at specified locations and as indicated on Drawings.
   b. Bond Coat: Modified dry-set mortar or medium-bed modified dry-set mortar as appropriate to tile.
   c. Grout: High-performance grout.

B. Shower Wall Tile Installations at Bonded Mortar Bed Shower Pans:

1. Cementitious Backing Panel Substrates: Install in accordance with TCNA B415.

   a. Provide waterproofing and crack isolation membrane.

b. Bond Coat: Modified dry-set mortar or medium-bed modified dry-set mortar as appropriate to tile.
c. Grout: High-performance grout.

END OF SECTION 09 3000

SECTION 09 5113 – ACOUSTICAL PANEL CEILINGS

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. Acoustical panels.
2. Metal suspension systems.

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. Samples for Initial Selection: For components with factory-applied finishes.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Metal Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including, but not limited to, the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: For each type, finish, and color, full-size panels equal to 2 percent of quantity installed but not less than one box.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed but not less than one box for each type, finish, and color.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area in locations directed by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.11 WARRANTY

A. Special Warranties: Provide the following manufacturer warranties:

1. Acoustic Panel Warranty: Manufacturer agrees to repair or replace panels that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

1) Sagging acoustical panels.
2) Mold and mildew growth on panels.

b. Warranty Period 30 years from date of Substantial Completion.

2. Metal Suspension Systems: Manufacturer agrees to repair or replace panels that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

1) Rusting grid members or components.

b. Warranty Period 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

B. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.2 ACOUSTICAL PANELS

A. Acoustical Panel: AC-01

1. Product: Subject to compliance with requirements, provide the following:

a. USG Corporation; USG Astro ClimaPlus Acoustical Panels, Item No. 8722: www.usg.com.
b. No substitutions.

2. Acoustical Panel: ASTM E1264.

a. Classification:

1) Type and Form: Type III, mineral base with painted finish; Form 1, nodular.

b. Pattern: G (smooth).

c. Performance Requirements:

1) Noise Reduction Coefficient (NRC): Not less than 0.50.
2) Ceiling Attenuation Class (CAC): Not less than 35.
3) Light Reflectance (LR): Not less than 0.86.

d. Size: 24 by 24 inches.
e. Thickness: 3/4 inch.
f. Edge/Joint Detail: Reveal edge (FLB).
g. Color: White.
h. Metal Suspension System: CG-01

2.3 METAL SUSPENSION SYSTEM

A. General:

1. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635 and designated by type, structural classification, and finish indicated.

B. Narrow-Face Reveal, 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 (Z90) coating designation; with prefinished 9/16-inch-wide slotted face with 1/4 inch reveal.

1. Drawing Designation: CG-01
2. Structural Classification: Intermediate-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: Painted white.
7. Product USG Corporation; USG Donn Brand Fineline DXFF: www.usg.com.

a. No substitutions.

C. Metal Edge Moldings and Trim: Provide edge molding and trim for each metal suspension-system.

1. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

a. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
b. 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.
c. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2. Miscellaneous Moldings: Same material, finish, and color as that used for exposed flanges of suspension-system runners.

a. Provide inside and outside prefabricated corner moldings.
b. At Bullnose Corners: Provide radius corner moldings to match bullnose radius of adjacent walls.

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635, 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 according to ASTM E488 or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Cast-in-place or postinstalled expansion anchors.
b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.

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

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653, G90 (Z275) coating designation; with bolted connections and 5/16-inch-diameter bolts.

2.5 ACOUSTICAL ACCESSORIES

A. Acoustic Insulation:

1. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.

a. Thickness: 3 inches, unless otherwise indicated.
b. Density: 2.5 pcf.
c. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
d. Products: Subject to compliance with requirements, provide one of the following:

1) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.
2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
3) Rockwool; Safe’n’Sound: www.rockwool.com.

B. Acoustical Sealant: As specified in Section 079200 - Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636 and manufacturer's written instructions.

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. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. 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.
6. 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.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. 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.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
4. Corners:

   a. At Bullnose Corners: Provide prefabricated radius corner moldings to match bullnose radius of walls.
   b. At Square Corners: Provide prefabricated corner moldings.

      1) At Other Angles Corners: Overlap perimeter moldings.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
2. 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.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

F. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions, unless otherwise indicated.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113

SECTION 09 6513 – 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 other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Resilient wall base.
2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

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

C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Wall Base: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, profile, and size installed.
2. Resilient Molding Accessories: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, profile, and size installed.
3. Resilient Stair Accessories: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, texture, profile, and size installed.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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).

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Drawing Designations: B-03.
2. Manufacturers: Subject to compliance with requirements, provide Tarkett Company; Perceptions/Contour: commercial.tarkett.com, or a comparable products by one of the following:

   a. Armstrong Flooring Inc.: www.armstrongflooring.com.
   b. Mannington Mills, Inc./Burke Flooring: www.manningtoncommercial.com.
   c. Johnsonite, a Tarkett Company: www.johnsonite.com.
   d. Roppe Corp: www.roppe.com.

3. Thickness: 0.125 inch.
4. Height: 4.25 inches.
5. Lengths: Coils in manufacturer's standard length.
6. Outside Corners: Job formed.
7. Inside Corners: Job formed.
8. Colors: Equal to colors indicated in Color Codes on Drawings.

2.2 RESILIENT MOLDING ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. Armstrong Flooring Inc.: www.armstrongflooring.com.

2. Mannington Mills, Inc./Burke Flooring: www.manningtoncommercial.com.
3. Johnsonite, a Tarkett Company: www.johnsonite.com.
4. Roppe Corp: www.roppe.com.
5. Tarkett Company: commercial.tarkett.com.

B. Resilient edge and transition strips for changes in flooring materials.

1. Material: Rubber.
2. Profile and Dimensions: As standard with manufacturer and as follows:

a. As appropriate for floor finishes.
b. As indicated on Drawings.

3. Provide floor moldings at the following locations unless otherwise indicated:

a. Open perimeters of resilient flooring; reducer strips.
b. Open perimeters of carpeting; edge guards.
c. Changes in floor finishes from resilient flooring to carpeting; transition strips.
d. Changes in elevation: Tapered substrate transition strips; provide for smooth flooring transitions.
e. Other areas as indicated on Drawings or required for complete floor finish installations.

4. Colors and Patterns: Equal to colors indicated in Color Codes on Drawings or, if not indicated, standard colors as selected by Architect.

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.

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. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. 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 in length.

a. Bend around corners; 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 in length.

a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Install floor moldings in one piece for full width of installation, where possible

1. Where joints are unavoidable, fit tightly together and align adjacent molding profiles

C. Butt to adjacent materials and tightly adhere to substrates throughout length of each piece.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from 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 09 6513

SECTION 09 6813 – TILE CARPETING

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. Carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Transition details to other flooring materials.

C. Samples for Initial Selection: For each type of carpet tile.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience, and as follows:

1. Shall be certified by the International Certified Floorcovering Installers Association at the Commercial II certification level

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.10 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 CARPET TILE

A. Carpet Tile: CPT-01

1. Product: Subject to compliance with requirements, provide the following:

a. Milliken; Counterculture, Freethinker: floors.milliken.com.
b. No substitutions.

2. Size: 19.7 by 19.7 inches.
3. Total Thickness: 0.318 inches.
4. Backing System: PVC-Free WellBAC Comfort Cushion.
5. Colors and Patterns:

a. Colors: As indicated in Color Codes on Drawings.
b. Patterns: As indicated on Drawings.

6. Installation Method: Ashlar, unless otherwise indicated on Drawings.

B. Carpet Tile: CPT-02

1. Product: Subject to compliance with requirements, provide the following:

a. Milliken; Counterculture, Phenom: floors.milliken.com.
b. No substitutions.

2. Size: 19.7 by 19.7 inches.

3. Total Thickness: 0.318 inches.
4. Backing System: PVC-Free WellBAC Comfort Cushion.
5. Colors and Patterns:

   a. Colors: As indicated in Color Codes on Drawings.
   b. Patterns: As indicated on Drawings.

6. Installation Method: Ashlar, unless otherwise indicated on Drawings.

C. Carpet Tile: CPT-03

1. Product: Subject to compliance with requirements, provide the following:

   a. Patcraft; Urban Relief, Suburban Abstract: www.patcraft.com.
   b. No substitutions.

2. Size: 24 by 24 inches.
3. Total Thickness: 0.229 inches.
4. Backing System: Non-woven synthetic, Strataworx.
5. Colors and Patterns:

   a. Colors: As indicated in Color Codes on Drawings.
   b. Patterns: As indicated on Drawings.

6. Installation Method: Monolithic, unless otherwise indicated on Drawings.

D. Carpet Tile: CPT-05

1. Product: Subject to compliance with requirements, provide the following:

   a. Milliken; Obex Entrance Flooring Cut: floors.milliken.com.
   b. No substitutions.

2. Size: 19.7 by 19.7 inches.
3. Total Thickness: 0.35 inches.
4. Backing System: PVC.
5. Colors and Patterns:

   a. Colors: As indicated in Color Codes on Drawings.
   b. Patterns: As indicated on Drawings.

6. Installation Method: Ashlar, unless otherwise indicated on Drawings.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer but not less than the following:

1. Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns as indicated on Drawings and as recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 6813

SECTION 09 6816 – SHEET CARPETING

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. Sheet carpeting.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Seam locations, types, and methods.
4. Type of subfloor.
5. Type of installation.
6. Pattern type, repeat size, location, direction, and starting point.
7. Pile direction.
8. Types, colors, and locations of insets and borders.
9. Types, colors, and locations of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples for Initial Selection: For each type of carpet.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet: 12 inch square Sample.
2. Carpet Seam: 6-inch Sample.

E. Product Schedule: For carpet. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For carpet, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience, and as follows:

1. Shall be certified by the International Certified Floorcovering Installers Association at the Commercial II certification level

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

B. Deliver carpet in original mill protective covering with mill register numbers and tags attached.

1.10 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.11 WARRANTY

A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Excess static discharge.
c. Loss of tuft-bind strength.
d. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 CARPET

A. Carpet: CPT-04

1. Product: Subject to compliance with requirements, provide the following:

a. Shaw Contract; Ribbons, 5A266: www.shawcontract.com.
b. No substitutions.

2. Roll Width: 12 feet.
3. Total Thickness: 0.420 inches.
4. Backing System: Synthetic, Ultraloc .
5. Colors and Patterns:

a. Colors: As indicated in Color Codes on Drawings.
b. Patterns: As indicated on Drawings.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.

C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.

B. Examine carpet for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

A. Comply with the Carpet and Rug Institute's CRI 104 and carpet manufacturer's written installation instructions for the following:

1. Direct-glue-down installation.

B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Install as indicated on Drawings.

D. Install borders with mitered corner seams.

E. Do not bridge building expansion joints with carpet.

F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with the Carpet and Rug Institute's CRI 104.

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION 09 6816

SECTION 09 7200 – WALL COVERINGS

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. Wall coverings using Owner material.
2. Vinyl wall coverings.
3. Acoustical wall coverings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection samples.

D. Samples for Verification:

1. Submit 3 samples of each type of wall covering, 4 by 4 inch in size, minimum; illustrating color, finish, and texture.

E. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience, and as follows:

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.

1. Install mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2.2 WALL COVERINGS

A. Wall Covering: WC-01

1. Owner furnished.

B. Vinyl Wall Coverings – WC-02:

1. Basis of Design Product: Subject to compliance with requirements, provide the following:

a. Arc-Com; Intuition, ACW-53518: www.arc-com.com

1) Substitutions not permitted.

2. ASTM F793/F793M for wall coverings.

a. Category: II, Decorative with Medium Serviceability.

3. Total Weight: 20 oz per lineal yard, excluding coatings.
4. Roll Width: 54 inches.
5. Backing: Non-woven.
6. Color: As indicated in Color Codes on Drawings.

C. Acoustical Wall Coverings – AWC-01:

1. Basis of Design Product: Subject to compliance with requirements, provide the following:

a. Filzfelt; 5mm Wool Design Felt: www.filzfelt.com

1) Substitutions not permitted.

2. Content: 100 percent Merino or Karakul wool.
3. Thickness: 3/16 inch (5mm).
4. Roll Width: 70-3/4 inches.
5. Backing: None.
6. Color: As indicated in Color Codes on Drawings.

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, as recommended in writing by wall-covering manufacturer for intended substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Gypsum Board: Apply primer/sealer as recommended in writing by wall-covering manufacturer.
3. Painted Surfaces:

a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by wall-covering manufacturer.
b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 7200

SECTION 09 9100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior painting.
2. Interior painting.
3. Dryfall coatings.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section

B. DFT: Dry film thickness, measured in mils.

C. WFT: Wet film thickness, measured in mils.

D. Mils: One one-thousandth of an inch. Used to measure thickness of coating films.

1.4 ACTION SUBMITTALS

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

1. Indicate VOC content.
2. Manufacturer's name, product name and/or catalog number, and general product category.

    a. Example of general product categories:

        1) Interior finish coat - latex, eggshell.
        2) Exterior primer for ferrous metal.

3. For each paint system and substrate, indicate which paint products are to be used.

    a. Examples:

        1) Interior latex eggshell system for gypsum board:

            a) Primer: Name of specific product provided.
            b) Finish Coats: Name of specific product provided.

        2) Exterior latex semigloss system for ferrous metals.

            a) Primer: Name of specific product provided.
            b) Finish Coats: Name of specific product provided.

4. Use same designations indicated on Drawings and Schedules.

B. Samples: Submit 3 paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating each color and sheen specified.

1. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry and storefront finishes, have been approved.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Paint Maintenance Manual: Submit coating maintenance manual including:

1. Finish schedule showing where each product, color, and sheen was used.
2. Product technical data sheets.
3. Material safety data sheets (MSDS).
4. Care and cleaning instructions.
5. Touch-up procedures.
6. Repair of painted and finished surfaces.

B. Color Chips: After final approval of all colors, submit color chips of all coatings used with manufacturer's name, product, and mix formulation of each color, sheen, and coating for the purpose of future re-ordering of coatings.

1. Color chips shall be at least six (6) inches square.
2. Include in Paint Maintenance Manual.

C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 2 percent of that installed, but not less than 1 gal. of each material, color, and sheen applied.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 5 years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years documented experience.

1. Only qualified journeypersons, as defined by local jurisdiction, shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.

C. Mockups: Apply mockups of each paint system indicated for each substrate, color, sheen, 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..

1) Include mock-up for each dryfall paint system and color.
2) Include mock-up for each non-bridging paint system and color.

3) Include mock-up for each video (green) screen paint system and color.
4) Include mock-up for each dry erase coatings system and color.

b. Doors and Frames: Provide mock-up samples of one complete door and frame.
c. Railings and Other Lineal Materials: Provide mock-up samples of at least 8 lineal feet.
d. Other Items: Architect will designate items or areas required.

2. Galvanized surfaces. For each galvanized surface, prepare substrate and apply a test patch prior to applying paint to entire fabrication:

a. After cleaning and preparing, apply a test patch of primer/paint and allow to dry for 7 days.
b. After 7 days, test primer/paint adhesion using method recommended by paint manufacturer.
c. Do not proceed with work until adhesion test is approved by Architect.

3. 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.

4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 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.

1.9 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 of less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

C. Apply paint only to dry, clean, and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:

1. Provide paint and coating products from same manufacturer, unless otherwise specified.
2. Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats, unless otherwise specified.
3. Exceptions shall be permitted, provided approval of Architect is obtained using specified procedures for substitutions.

B. Paint Manufacturers - General: For each paint type specified in Part 2, provide one of the products listed, subject to compliance with requirements. Products shall be from one of the following:

1. Benjamin Moore: Benjamin Moore & Co.: www: benjaminmoore.com.
2. PPG: PPG Industries, Inc., Architectural Coatings: www.ppgpaints.com.
3. Sherwin-Williams: The Sherwin-Williams Company: www: sherwin-williams.com.

2.2 AINT MATERIALS, GENERAL

A. 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.

B. VOC Content:

1. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction
2. For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits unless stricter limits are required by authorities having jurisdiction:

a. Flat Paints and Coatings: 50 g/L.
b. Nonflat Paints and Coatings: 50 g/L.
c. Dry-Fog (Dryfall) Coatings: 150 g/L.
d. Primers, Sealers, and Undercoaters: 100 g/L.
e. Rust-Preventive Coatings: 100 g/L.
f. Zinc-Rich Industrial Maintenance Primers: 100 g/L.

C. Supply each paint material in quantity required to complete entire project's work from a single production run.

D. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

E. Sheen/Gloss Criteria.

1. Product names are not acceptable as gloss level identification.
2. Determine gloss value of paint finish by testing paint samples according to ASTM D523, using 60 degree geometry. Sheen/Gloss levels shall be defined as follows:

a. Gloss Level 1: Flat/Matte, value between 0 and 5 units.
b. Gloss Level 2: Velvet, value between 5 and 10 units.
c. Gloss Level 3: Eggshell, value between 10 and 20 units.
d. Gloss Level 4: Satin, value between 20 and 35 units.
e. Gloss Level 5: Semigloss, value between 35 and 70 units.
f. Gloss Level 6: Gloss, value between 70 and 85 units.
g. Gloss Level 7: High Gloss, value more than 85 units.

3. Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

F. Colors: As indicated in Room Finish Schedule on Drawings or, if not indicated, to match Architect's samples.

1. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as indicated color.
2. Provide tinted deep tone primers at deep tone colors, and as recommended by paint manufacturer.

2.3 EXTERIOR PAINTS

A. General:

1. Unless otherwise indicated, each exterior paint system consists of the following:

a. Primer: One coat based on substrate material.
b. Finish Coats: Two coats based on required sheen and substrate material.

2. Required Sheens: For each paint system, provide paint sheens as follows unless otherwise indicated:

a. All exterior paint systems: Semigloss.

B. Exterior Paint Systems - Latex

1. Primers:

a. Primer for cementitious plaster: Alkali-resistant acrylic/latex primer, water-based.

1) Benjamin Moore; Super Spec Masonry Interior/Exterior Hi-Build Masonry Primer, N068; DFT 1.0 mils
2) PPG; Perma-Crete Concrete and Stucco Primer, 4-503; DFT 2.0 mils.
3) Sherwin Williams; Loxon Concrete & Masonry Primer/Sealer Interior/Exterior Latex, A24W8300 Series; DFT 2.5 mils.

b. Primer for aluminum, ferrous metal, and galvanized steel: Rust-inhibitive acrylic/latex primer, water-based.

1) Benjamin Moore; Super Spec HP Acrylic Metal Primer, P04; DFT 2.0 mils.
2) PPG; Pitt-Tech Plus Int./Ext. DTM Industrial Primer, 90-912 Series; DFT 3.0 mils.
3) Sherwin Williams; Pro Industrial DTM Acrylic Primer/Finish, B66W1 Series; DFT 3.5 mils.

c. Primer for previously painted surfaces; including concrete and masonry: Acrylic/latex stain-blocking primer/sealer with high adhesion, water-based.

1) Benjamin Moore; Fresh Start High-Hiding All Purpose Primer, 046; DFT 1.4 mils.
2) PPG; Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921 Series; DFT 1.6 mils.
3) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.

2. Finish Coats:

a. Semigloss Sheen: Acrylic/latex paint, water-based.

1) Finish coats for all surfaces except metals:

a) Benjamin Moore; Aura Waterborne Exterior Paint Semi-Gloss Finish 632; DFT 1.7 mils.

b) PPG; Speedhide Exterior 100% Acrylic Semi-Gloss, 6-900XI Series; DFT 1.4 mils.
c) Sherwin-Williams; SuperPaint Exterior Latex Gloss, A84 Series; DFT 1.5 mils.

2) Finish coats for aluminum, ferrous metal, and galvanized steel:

a) Benjamin Moore; Ultra Spec HP DTM Acrylic Semi-Gloss, WH29; DFT 2.3 mils.
b) PPG; Pitt-Tech Plus Int./Ext. Semi-Gloss DTM Industrial Enamel, 90-1210 Series; DFT 2.0 mils.
c) Sherwin-Williams; Pro Industrial DTM Acrylic Semi-Gloss, B66W01100 Series; DFT 2.5 mils.

2.4 INTERIOR PAINTS

A. General:

1. Unless otherwise indicated, each interior paint system consists of the following:

a. Primer: One coat based on substrate material.
b. Finish Coats: Two coats based on required sheen and substrate material.

2. Required Sheens: For each paint system, provide paint sheens as follows unless otherwise indicated:

a. Ceilings, Soffits and Ceiling Drops: Flat sheen.
b. Gypsum Board (except at ceilings):

1) Semigloss Sheen: Storage rooms, janitor closets, electrical rooms, mechanical rooms, closets, and similar non-public areas.
2) Eggshell Sheen: Public areas.

c. Metals: Semigloss sheen.
d. Insulated Piping and Insulated Ductwork: Sheen to match surface it is mounted on unless otherwise indicated.

B. Interior Paint Systems - Latex.

1. Primers:

a. Primer cementitious plaster: Alkali-resistant acrylic/latex primer, water-based.

1) Benjamin Moore; Super Spec Masonry Interior/Exterior Hi-Build Masonry Primer, N068; DFT 1.0 mils
2) PPG; Perma-Crete Interior/Exterior Alkali Resistant Primer, 4-603; DFT 1.5 mils.
3) Sherwin Williams; Loxon Concrete & Masonry Primer/Sealer Interior/Exterior Latex, A24W8300 Series; DFT 2.5 mils.

b. Primer for aluminum, ferrous metal, and galvanized steel: Rust-inhibitive acrylic/latex primer, water-based.

1) Benjamin Moore; Super Spec HP Acrylic Metal Primer, P04; DFT 2.0 mils.
2) PPG; Pitt-Tech Plus Int./Ext. DTM Industrial Primer, 90-912 Series; DFT 3.0 mils.
3) Sherwin Williams; Pro Industrial DTM Acrylic Primer/Finish, B66W1 Series; DFT 3.5 mils.

c. Primer for gypsum board: Acrylic/latex primer, water-based.

1) Benjamin Moore; Ultra Spec 500 Interior Latex Primer, N534; DFT 1.4 mils.

2) PPG; Pure Performance Interior Latex Primer - 9-900; DFT 1.4 mils.
3) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W02600; DFT 1.0 mils.

d. Primer for previously painted surfaces; including concrete and masonry: Acrylic/latex stain-blocking primer/sealer with high adhesion, water-based.

1) Benjamin Moore; Sure Seal Latex Primer Sealer, 027; DFT 1.3 mils.
2) PPG; Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921 Series; DFT 1.6 mils.
3) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.

e. Primer for insulated piping and insulated ductwork: Acrylic/latex stain-blocking primer/sealer with high adhesion, water-based.

1) Benjamin Moore; Sure Seal Latex Primer Sealer, 027; DFT 1.3 mils.
2) PPG; Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921 Series; DFT 1.6 mils.
3) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.

2. Finish Coats:

a. Semigloss Sheen: Acrylic/latex paint, water-based.

1) Finish coats for all surfaces except metals:

a) Benjamin Moore; Ultra Spec 500 Interior Semi-gloss Finish, N539; DFT 1.8 mils.
b) PPG; Speedhide Zero Interior Zero-VOC Latex Semi-Gloss, 6-4500 Series; DFT 1.3 mils.
c) Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series; DFT 1.6 mils.

2) Finish coats for aluminum, ferrous metal, and galvanized steel:

a) Benjamin Moore; Ultra Spec HP DTM Acrylic Semi-Gloss, WH29; DFT 2.3 mils.
b) PPG; Pitt-Tech Plus Int./Ext. Semi-Gloss DTM Industrial Enamel, 90-1210 Series; DFT 2.0 mils.
c) Sherwin-Williams; Pro Industrial DTM Acrylic Semi-Gloss, B66W01100 Series; DFT 2.5 mils.

b. Eggshell Sheen: Acrylic/latex paint, water-based.

1) Finish coats for all surfaces:

a) Benjamin Moore; Ultra Spec 500 Interior Eggshell Finish, N538; DFT 1.8 mils.
b) PPG; Speedhide Zero Interior Zero-VOC Latex Eggshell, 6-4300 Series; DFT 1.5 mils.
c) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series; DFT 1.7 mils.

c. Flat Sheen: Acrylic/latex paint, water-based.

1) Finish coats for all surfaces:

a) Benjamin Moore; Benjamin Moore; Ultra Spec 500 Interior Flat Finish, N536; DFT 1.8 mils.
b) PPG; Speedhide Zero Interior Zero-VOC Latex Flat, 6-4100 Series; DFT 1.4 mils.
c) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series; DFT 1.6 mils.

2.5 DRYFALL COATINGS

A. General:

1. Unless otherwise indicated, each interior dryfall coating system consists of the following:

a. Primer: One coat based on substrate material.
b. Finish Coats: One or two coats as recommended by dryfall coating manufacturer and based on required sheen.

2. Required Sheens: For each interior dryfall coating system, provide paint sheens as follows unless otherwise indicated:

a. All dryfall coating systems: Flat.

B. Interior Dryfall Paint Systems - Flat Sheen, Latex:

1. Primers:

a. Primer for concrete: Acrylic/latex dryfall paint, water-based.

1) Benjamin Moore; Latex Dry Fall Flat, 395; DFT 1.9 mils
2) PPG; Speedhide Super Tech WB Interior Dry-Fog Flat, 6-725XI; DFT 2.2 mils.
3) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat, B42 Series; DFT 2.0 mils

b. Primer for ferrous metal and aluminum: Rust-inhibitive acrylic/latex primer, water-based:

1) Benjamin Moore; Super Spec HP Acrylic Metal Primer, P04; DFT 2.0 mils.
2) PPG; Pitt-Tech Int./Ext. DTM Industrial Primer, 90-712 Series; DFT 2.5 mils.
3) Sherwin Williams; Pro Industrial DTM Acrylic Primer/Finish, B66W1 Series; DFT 3.5 mils.

c. Primer for galvanized steel: Acrylic/latex dryfall paint, water-based.

1) Benjamin Moore; Latex Dry Fall Flat, 395; DFT 1.9 mils
2) PPG; Speedhide Super Tech WB Interior Dry-Fog Flat, 6-725XI; DFT 2.2 mils.
3) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat, B42 Series; DFT 2.0 mils

2. Finish Coats:

a. Flat Sheen: Acrylic/latex dryfall paint, water-based.

1) Benjamin Moore; Latex Dry Fall Flat, 395; DFT 1.9 mils.
2) PPG; Speedhide Super Tech WB Interior Dry-Fog Flat, 6-725XI; DFT 2.2 mils.

3) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat, B42 Series; DFT 2.0 mils.

2.6 ACCESSORY MATERIALS

A. Accessory Materials: Provide cleaning materials, preparation materials, and miscellaneous materials required to properly prepare and apply paints and coatings.

1. Includes materials required for marking fire and smoke assemblies

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. Gypsum Board: 12 percent.
2. Portland Cement Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. 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 applicable to substrates and paint systems indicated.

B. Protect adjacent surfaces not to be painted.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. For coatings applied over previously painted surfaces, test application to check for lifting and other adhesion problems. Perform test in an isolated area where practicable.
2. Remove incompatible coatings and primers or apply barrier tie coat as recommended by paint manufacturer and as required to produce paint systems indicated.

D. 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.

E. Steel Substrates - Unpainted or Unprimed: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 6 - Commercial Blast Cleaning.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Sand and scrape to remove loose primer and rust. Feather edges of remaining primer to make inconspicuous.

1. Before painting, applicator/installer shall re-prime entire shop-primed item with primer specified in this section.

G. Galvanized-Metal Substrates: Remove passivation coating/rinse, grease and oil residue from galvanized metal to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Clean using methods recommended in writing by paint manufacturer but not less than ASTM D6386, ASTM D7396, and the following:

1. Remove surface contamination and oils in accordance with SSPC-SP 1 - Solvent Cleaning.
2. Remove loose paint, rust, and other debris according to SSPC-SP 2 - Hand Tool Cleaning.
3. Lightly profile galvanized surfaces and remove zinc oxide and zinc hydroxide layers in accordance with SSPC-SP16 – Brush-Off/Sweep Blast Cleaning.
4. Apply paint within 1 hour of cleaning and preparation.

H. Aluminum Substrates: Remove loose surface oxidation. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 1 - Solvent Cleaning.

I. Previously Painted Surfaces - General:

1. Remove all surface contamination such as, oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, and any other surface contamination.
2. Remove masking tape, labels, adhesives, and other materials that would either be deleterious to adhesion of, or show through, new paint.
3. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.
4. Spot prime all bare areas with appropriate primer before priming entire surface.

J. Repair of Existing Gypsum Board:

1. Fill hairline cracks, small holes, and imperfections with filler compound and sand smooth.

K. Repair of Existing Cementitious Plaster:

1. Fill hairline cracks, small holes, and imperfections with exterior patching plaster and make smooth.

3.3 APPLICATION - GENERAL

A. Apply paints and coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.

B. Provide smooth, opaque coatings of uniform finish, color, appearance, and coverage without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.

C. Terminate paint in neat lines; cut in sharp lines and color breaks.

D. Apply paint products to properly prepared surfaces.

1. Do not apply coatings over dirt, rust, scale, grease, moisture, or other conditions detrimental to application of coatings.

E. Primers:

1. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
2. Apply first coat of primer to surfaces as soon as practical after preparation and before subsequent surface deterioration.
3. Re-prime shop-primed surfaces.

F. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.

1. Sand between coats as recommended by manufacturer; before applying next coat clean surfaces of loose particles and use tack cloth to remove any remaining dust and particles just prior to applying next coat.

G. Provide completed work matching approved samples for color, sheen, texture, coverage and quality of work.

1. Remove, refinish, or repaint work not complying with requirements.

H. Number of Coats: Each paint system in Part 2 specifies a number of coats. This is the minimum number required.

1. If undercoats, stains, or other imperfections are visible after final coat of paint, apply additional coats until paint is of uniform finish, color, and appearance without defects or imperfections.

I. Minimum Coating Thickness: Provide dry film thickness for each coating as indicated, but not less than that recommended by the coating manufacturer.

1. Number of coats and film thicknesses required are same regardless of application method.
2. Ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.

3.4 DRYFALL APPLICATION

A. Dryfall overspray may adhere to hot surfaces; protect hot equipment and surfaces not intended to be painted from overspray.

3.5 **SURFACES TO BE PAINTED**

A. General: Paint all exposed surfaces except where indicated not to be painted or where listed in “Surfaces Not to Be Painted” Article in this section.

1. The term "exposed" includes areas visible through permanent and built-in fixtures when they are in place.
2. If surface, material, or item is not specifically mentioned, paint in same manner, color, and sheen as similar surfaces, materials, or items, regardless of whether indicated or not.
3. Paint surfaces that are cut and patched including, but not limited to, cutting and patching to permit installation of electrical services, piping, and ductwork.

B. Equipment and Furniture:

1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.

2. Paint surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of permanent item.

C. Registers and Grilles: Paint interior surfaces of ducts, for a minimum of 18 inches or beyond sight line, whichever is greater, with a flat black (non-reflecting) paint.

D. Access Panels: Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

E. Doors:

1. Exterior Doors: Finish doors on tops, bottoms, and all four edges the same as exterior faces.
2. Interior Doors: Finish doors on tops, bottoms, and all four edges the same as face of non-secured side.

F. Panelboards for Service Panels, Telephone, and Other Electrical Equipment:

1. Paint both sides and all edges of plywood before installation.

a. Color and Sheen: Gray, semigloss, unless otherwise indicated.

G. Mechanical and Electrical:

1. This Section includes painting of all mechanical, fire protection, and electrical items.

a. Do not paint sprinkler heads and polished fire protection components.
b. Do not paint insulated pipe, duct work or equipment before insulation is applied.

2. Piping, Insulated Piping, Pipe Hangers, and Supports:

a. In finished/public areas, paint exposed piping the same color and sheen as surface it is mounted on unless otherwise indicated.
b. In utility areas, paint exposed piping according to piping color coding scheme; otherwise paint the same color and sheen as surface it is mounted on unless otherwise indicated.
c. Paint all exposed pipe hangers and supports the same color and sheen as surface it is mounted on unless otherwise indicated.

1) Any portion of hangers and supports encompassing the actual pipe shall be painted to match the pipe color and sheen.

3. Ductwork, Insulated Ducts, and Supports:

a. In finished/public areas, paint exposed ductwork and supports the same color and sheen as surface it is mounted on unless otherwise indicated.
b. In utility areas, paint exposed ductwork according to color coding scheme; otherwise paint the same color and sheen as surface it is mounted on unless otherwise indicated.
c. Paint all exposed hangers and supports the same color and sheen as surface it is mounted on unless otherwise indicated.

1) Any portion of hangers and supports encompassing the actual ductwork shall be painted to match the ductwork color and sheen.

4. Electrical Conduit, Fittings and Junction Boxes:

a. In finished/public areas, paint exposed conduit, fittings and junction boxes same color and sheen as surface it is mounted on unless otherwise indicated.

b. In utility areas, paint exposed conduit, fittings and junction boxes according to color coding scheme; otherwise paint the same color and sheen as surface it is mounted on unless otherwise indicated.

5. Mechanical and Electrical Equipment:

a. Exterior Equipment: Paint all equipment exposed to the weather.

1) Do not paint factory-finished equipment unless otherwise indicated.

b. Paint shop-primed mechanical and electrical equipment same color and sheen as surface it is mounted on unless otherwise indicated.
c. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
d. Paint interior surfaces of convector and baseboard heating cabinets to match face panels.

3.6 SURFACES NOT TO BE PAINTED

A. Do not paint or finish the following unless otherwise indicated:

1. Factory-finished items; factory-primed items are not considered factory-finished.
2. Items indicated to receive other finish.
3. Items indicated to remain naturally finished.
4. Fire rating labels.
5. Equipment serial number and capacity labels.
6. Operating parts of equipment.
7. Aluminum components.
8. Polished and brushed stainless steel items.
9. Metal flashings.
10. Brick.
11. Decorative concrete masonry units.
12. Cast-in-place concrete.
13. Floors.
14. Surfaces concealed by suspended ceilings.
15. Concealed piping, ductwork, and conduit.
16. Surfaces within pipe and duct spaces.
17. Acoustical materials.

3.7 IDENTIFICATION AND COLOR CODING

A. Marking Fire and Smoke Assemblies.

1. Permanently identify both sides of each fire and smoke assembly indicated on Drawings.

a. Labeling:

1) Labeling may be either painted stencils or preprinted self-adhesive stickers.
2) Lettering not less than 3 inches in height, minimum 3/8 inch stroke width, in contrasting color to wall. Example of wording as follows:

a) "2 HOUR FIRE BARRIER - PROTECT ALL OPENINGS" or similar.

3) Colors and exact wording of labels shall comply with local code(s).

b. Locations:

1) Locate labels within 15 feet of the ends of each wall and intervals not to exceed 30 feet measured horizontally along the wall. Minimum of one label per run of wall.

a) Locate approximately 12 to 24 inches below ceiling/roof deck unless otherwise required by local code(s).
b) In occupied areas without ceilings do not apply labels.

c. Where multiple ratings occur in single run of wall:

1) Apply vertical stripe 2 inches wide and approximately 12 inches high where rating change occurs; use contrasting color to wall.
2) In occupied areas without ceilings do not apply.
3) Comply with local code(s).

B. Mechanical and Electrical Identification and Color Coding:

1. Refer to Divisions 21, 22, 23, and 26 for color coding scheme and identification of mechanical and electrical services; if no identification is provided, paint as follows:

a. Color Coding Scheme and Identification:

1) Piping: None; paint to match surface on which it is mounted.
2) Ductwork: None; paint to match surface on which it is mounted.
3) Conduit: None; paint to match surface on which it is mounted.

3.8 **FIELD QUALITY CONTROL**

A. Subject to the opinion of the Architect, paint shall be rejected and considered unacceptable for any of the following reasons:

1. Lacking minimum dry film thicknesses.
2. Poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, and corners.
3. Damage from touching, or disturbing paint in any other manner, before sufficiently dry.
4. Damage from application to moist surfaces or damage caused by inadequate protection from the weather.
5. Damage or contamination of paint from blown contaminants including but not limited to dust.
6. Paint shall be rejected if any of the following are evident under natural lighting for exterior surfaces and final lighting source, including daylighting, for interior surfaces:

a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.

B. Visible defects are defined as follows:

1. Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
2. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

C. Rejected paint shall be repaired or replaced at the expense of the Contractor.

1. Small affected areas shall be touched up.
2. Large affected areas shall be repainted.
3. Small and large areas shall be as defined by the Architect.
4. Areas without sufficient dry film thickness shall be repainted.
5. Paint runs and sags shall be removed by scraper or sanding and repainted.

3.9 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water. Prevent solvents, thinners, cleaners, and other contaminants from entering waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

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.

END OF SECTION 09 9100

SECTION 10 1100 – VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Glass markerboards.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.

C. Samples for Initial Selection: For each type of exposed finish.

D. Samples for Verification:

1. Markerboard Finishes: Not less than 2 by 2 inches for each color and finish.
2. Trim: 6-inch-long sections ofIncluding chalk trays.

E. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section; with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section; With minimum five years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

A. Special Warranty for Glass Writing Surfaces: Manufacturer agrees to repair or replace glass writing surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.

2. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 GLASS MARKERBOARDS

A. Basis of Design Product: Subject to compliance with requirements, provide Claridge Products and Equipment, Inc: Frameless Claridge Glass Markerboard: www.claridgeproducts.com or a comparable product by one of the following:

1. ADP Lemco, Inc.; www.adplemco.com.
2. ASI Visual Display Products, Inc., an ASI Group Company: www.asi-visualdisplayproducts.com.
3. Egan Visual, Inc.; www.egan.com.
4. Ghent, a GMi company; www.ghent.com.
5. Marsh Industries, Inc.; www.marsh-ind.com.
6. Platinum Visual Systems; www.pvsusa.com.
7. PolyVision Corporation: www.polyvision.com.

B. Glass Markerboards: Fabricated of 6-mm tempered low-iron glass with steel backing for use with magnets.

1. Ultraclear Tempered Glass (Low Iron): ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with visible light transmission of not less than 91 percent.
2. Edge Treatment: Smooth polished edge with eased corners.
3. Color and Gloss : As selected from manufacturer's complete line of colors.

C. Mounting: Manufacturer's standard concealed system, Z-shaped brackets.

D. Marker Tray: Aluminum, attached with magnet.

1. Extruded Aluminum: ASTM B221, Alloy 6063.

E. Size: 5 by 10 feet, unless otherwise indicated on Drawings.

2.2 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Verify wall surfaces indicated to receive visual display units have been prime painted, at the minimum.

3.3 INSTALLATION

A. Install in accordance with visual display surface manufacturer's written instructions.

B. Install visual display surfaces in locations and at mounting heights indicated on Drawings.

C. Keep perimeter lines straight, level, and plumb.

D. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 CLEANING AND PROTECTION

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 1100

SECTION 10 1400 – SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Dimensional characters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each sign type.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.
4. Include material descriptions.
5. Indicate color and finishes.

C. Samples for Verification:

1. Dimensional Characters: Submit full size sample, of each dimensional character style, font, color, and method of attachment.

   a. For specified sizes 12 inches and under, provide samples matching specified size.
   b. For specified sizes over 12 inches, provide 12 inch high samples unless actual specified size requested by Architect.

D. Product Schedule: Use same designations indicated on Drawings or specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section and with at least 5 years of documented experience.

1.7 WARRANTY

A. Special Warranty – Dimensional Characters: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Dimensional Characters: Subject to compliance with requirements, provide products from one of the following:

1. A.R.K. Ramos: www.arkramos.com.
2. Gemini Inc.: www.geminisignproducts.com.

B. Source Limitations:

1. Dimensional Characters: Obtain from single source from single manufacturer.

2.2 MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.3 DIMENSIONAL CHARACTERS

A. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:

1. Character Material: Sheet or plate aluminum.
2. Character Heights: As indicated on Drawings.
3. Thickness: Manufacturer's standard for size of character but not less than 0.25 inch.
4. Typeface/Fonts: As indicated on Drawings.
5. Includes Logo: Shape and design as indicated on Drawings.
6. Finishes:

a. Integral Aluminum Finish: Clear anodized finish, brushed.

7. Mounting: Projecting studs (pin mounted).

a. Projected Mounting: Unless otherwise indicated, mount dimensional characters 1 inch off substrate; from face of substrate to back of dimensional character.
b. Provide fasteners as applicable for substrates indicated.

2.4 ACCESSORIES

A. Mounting Hardware: Provide all related fasteners and hardware required for a complete installation at substrates indicated.

B. Dimensional Characters:

1. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

a. Use concealed fasteners and anchors unless indicated to be exposed.
b. Sign Mounting Fasteners:

1) Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Dimensional Characters:

1. Comply with AWS for recommended practices in welding. Provide welds behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1400

SECTION 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES

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. Toilet accessories.
2. Shower accessories.
3. Electric dryers.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify accessories using designations indicated on Drawings

C. Samples for Initial Selection: For each type of finish material indicated.

D. Samples for Verification: When requested by Architect, for each type of material, color, and finish required, 2 by 2 inches in size:

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranty: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 15 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of toilet, shower, and electric dryer accessory from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
2. Shower Seats: Installed units are able to resist 350 lbf applied in any direction and at any point.
3. Diaper Changing Stations: Engineered to support minimum of 300-lb static load when opened.

2.3 MATERIALS

A. Stainless Steel: ASTM A240 or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.5 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.6 TOILET ACCESSORIES

A. Toilet Paper Dispenser - Bracket Type:

1. Description: Single roll bracket, pivoting.
2. Mounting: Surface mounted.
3. Material: Metal as standard with manufacturer.
4. Finish: As selected by Architect.
5. Product: Subject to compliance with requirements, provide Kohler Co.; Purist Pivoting Toilet Paper Holder, K-14377 : www.kohler.com.

   a. Substitutions not permitted.

B. Soap Dispenser – Wall Mounted:

1. Description: Manual wall-mounted soup dispenser with refill indicator, hinged lid, and lock.
2. Mounting; Wall mounted; horizontal orientation.
3. Operation: Designed for manual operation and dispensing soap in liquid or lotion form.
4. Capacity: 40 oz.
5. Material: Stainless steel with plastic dispenser valve.
6. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc.; B-4112: www.bobrick.com , or a comparable product by one of the following:

   a. American Specialties, Inc, (ASI): www.americanspecialties.com.
   b. Bradley Corporation: www.bradleycorp.com.

C. Mirrors:

1. Description: Glass mirror with glass beaded trim
2. Hangers: Manufacturer's standard.
3. Sizes:

   a. Type 1: 31-1/2 by 47-1/4 inches.
   b. Type 2: 23-3/4 by 63 inches.

4. Products: Subject to compliance with requirements, provide the following; substitutions not permitted:

   a. Type 1: MDC Interior Solutions; MHE8109 – Gemma Mirror: www.mdcwall.com.
   b. Type 2: MDC Interior Solutions; MHE8104 – Gemma Tall Mirror: www.mdcwall.com.

D. Grab Bars:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel with smooth, satin, slip-resistant finish.
3. Outside Diameter: 1-1/2 inches.
4. Configuration and Length: As indicated on Drawings.
5. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc.; B-6806 Series: www.bobrick.com , or a comparable product by one of the following:

   a. American Specialties, Inc, (ASI): www.americanspecialties.com.
   b. Bradley Corporation: www.bradleycorp.com.

E. Waste Receptacle:

1. Description: Open-top freestanding waste receptacle.
2. Minimum Capacity: 60 litre.
3. Material: Stainless steel, brushed finish.
4. Basis-of-Design Product: Subject to compliance with requirements, provide Simplehuman.com; Semi-round open can 60L, or a comparable product by one of the following:

   a. Or approved equal.

2.7 SHOWER ACCESSORIES

A. Towel Bar:

1. Description: Round tube bar and end brackets.
2. Mounting: Surface mounted.
3. Material: Solid brass.
4. Finish: As selected by Architect.
5. Width: 24 inches.
6. Product: Subject to compliance with requirements, provide Kohler Co.; Purist Towel Bar, K-14436 : www.kohler.com.

   a. Substitutions not permitted.

B. Robe Hook - Single:

1. Description: Single-prong unit, rectangular shaped with round backplate and concealed fasteners.
2. Material: Metal as standard with manufacturer.
3. Finish: As selected by Architect.
4. Product: Subject to compliance with requirements, provide Kohler Co.; Avid Robe Hook, K-97499 : www.kohler.com.

   a. Substitutions not permitted.

C. Shower Curtain Rod:

1. Description: 1-1/4-inch outside diameter, 0.05 inch (18 gage) thick, straight rod.
2. Length: As indicated on Drawings.

3. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
4. Material: Stainless steel.
5. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc.; B-6047: www.bobrick.com , or a comparable product by one of the following:

   a. American Specialties, Inc, (ASI): www.americanspecialties.com.
   b. Bradley Corporation: www.bradleycorp.com.

D. Shower Curtain:

1. Curtain Material: Nylon-reinforced vinyl, minimum 9 oz. or 0.008-inch-thick vinyl, with integral antibacterial and flame-retardant agents.

   a. Size: Refer to Drawings; minimum 6 inches wider than opening by 72 inches high; except as follows:

      1) Minimum 12 inches wider at openings wider than 48 inches.

   b. Color: White.
   c. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.

2. Shower Curtain Hooks: Stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
3. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc.; B-204: www.bobrick.com , or a comparable product by one of the following:

   a. American Specialties, Inc, (ASI): www.americanspecialties.com.
   b. Bradley Corporation: www.bradleycorp.com.

E. Folding Shower Seat:

1. Configuration: L-shaped seat, designed for wheelchair access.
2. Mounting: Surface mounted.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Frame: Stainless steel welded seat frame and structural support.
5. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc.; B-5181: www.bobrick.com , or a comparable product by one of the following:

   a. American Specialties, Inc, (ASI): www.americanspecialties.com.
   b. Bradley Corporation: www.bradleycorp.com.

2.8 ELECTRIC DRYERS

A. Electric Hand Dryers – High Speed: High Speed, high performance hand dryer, with downward fixed nozzle.

1. Operation: Automatic, sensor-operated on and off.
2. Mounting: Surface mounted.

   a. Maximum Projection from Wall: 4 inches.

3. Cover: Stainless steel with brushed finish.

   a. Tamper-resistant screw attachment of cover to mounting plate.
   b. Screened or shielded air intake.
   c. Screen or shield to prevent access to motor/heater.

4. Air Flow: 60 CFM, minimum.
5. Air Velocity: 16,000 linear feet per minute, minimum, at full power.
6. Fan/Heater Control: Field adjustable fan speed and heater on/off selection.
7. Noise: 75dB, maximum, 72 inches from unit; with hands under nozzle.
8. Total Wattage: 1000 W, maximum.
9. Runtime: Field adjustable, from approximately 10 seconds to approximately 35 seconds.
10. Supply Voltage: 240 V, single phase, 60 Hz, nominal, unless otherwise indicated.
11. Warranty: 5 years.
12. Product: Subject to compliance with requirements, provide World Dryer Corp.; VERDEdri: www.worlddryer.com.

    a. Substitutions not permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 2800

SECTION 12 2413 – ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades.
2. Motor-operated roller shades.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade Material: Not less than 2 by 3 inches for each color and finish.
3. Installation Accessories: Full-size unit, not less than 10 inches long.
4. Roller Shade: At Architect’s request, provide full-size operating unit, not less than 16 inches wide by 36 long for each type of roller shade indicated.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

D. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades 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. Roller Shades: Full-size units equal to 2 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.
2. Drive Chain: Quantity equal to 2 percent of total installed, but not less than 100 lineal feet.
3. Clutch Operator: Quantity equal to 2 percent of total installed, but not less than 2 units.
4. Mounting Brackets: Quantity equal to 2 percent of total installed, but not less than 2 pair.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.10 WARRANTY

A. Warranties: Provide manufacturers' standard warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Shade Hardware, excluding drive chains: 10 years.
2. Electric Motors: 5 years.
3. Electronic Control Equipment: 5 years.
4. Fabric: 10 years.
5. Aluminum and Steel Coatings: One year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Draper, Inc: draperinc.com.
2. Hunter Douglas Architectural: hunterdouglasarchitectural.com.
3. Legrand North America, LLC: legrand.us/solarfective.aspx.
4. Levolor: commercial.levolor.com.
5. Lutron Electronics Co. Inc.: lutron.com
6. MechoShade Systems, LLC: mechoshade.com.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 ROLLER SHADES, GENERAL

A. Refer to Drawings for roller shade configurations and installation methods, including:

1. Roller shade locations.
2. Manual or motorized operation.
3. Single or double roller configurations.
4. Shadeband materials.
5. Installation methods including front fascias, exposed headboxes, and recessed shade pockets.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Single Rollers:

a. Roller Drive-End Location: Right side of interior face of shade unless otherwise indicated on Drawings.
b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

2. Shadeband-to-Roller Attachment: Adhesive strip or removable spline fitting into integral channel in tube.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

1. Provide mounting hardware as recommended by manufacturer for mounting conditions and substrates indicated on Drawings

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

1. Provide as indicated on Drawings or as recommended by manufacturer.

E. Shadebands:

1. Single Rollers:

a. Shadeband Material: Light-filtering fabric.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material or exposed with endcaps as standard with manufacturer.

1) For shadebands with light-blocking fabric, provide integral light seal at bottom where hem bar meets the sill.

F. Installation Accessories:

1. For each roller shade provide one of the following in accordance with mounting conditions and details indicated on Drawings

a. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

1) Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.

G. Color and Finish:

1. For metal components exposed to view provide manufacturer's standard baked enamel or powder coated finish

a. Colors Standard color as selected by Architect.

2. For plastic components exposed to view:

a. Colors Standard color as selected by Architect.

2.3 MANUALLY OPERATED SHADES

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal or stainless steel.

a. Chain Break Strength: 95 pounds, minimum.
b. Loop Length: Full length of roller shade.
c. Limit Stops: Provide upper and lower ball stops.
d. Chain-Retainer Type: Chain tensioner, jamb or sill mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

2.4 MOTOR-OPERATED ROLLER SHADES

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

   a. Electrical Characteristics: 120 volts, single phase, 60 Hz, unless otherwise indicated.
   b. Maximum Total Shade Width: As required to operate roller shades indicated.
   c. Maximum Shade Drop: As required to operate roller shades indicated.
   d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

   a. Control Station: Maintained-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions.

      1) Control roller shades individually or in groups as indicated on Drawings and as recommended by manufacturer.

4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

2.5 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric - SC-01, SC-02: Woven fabric, stain and fade resistant.

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

   a. Phifer, Inc.: SheerWeave 2410: www.phifer.com

      1) Substitutions not permitted.

2. Type: PVC-coated polyester.
3. Performance Requirements:

   a. UV Blockage: 95 percent, minimum.
   b. Fungal Resistance: No growth when tested according to ASTM G21.

4. Openness Factor: 3 percent.
5. Colors:

   a. SC-01: As indicated in Color Codes and Window Shade Schedule on Drawings.

2.6 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

a. Extend shades 2 inches, plus or minus 1/8 inch, beyond jambs on each side if not otherwise indicated.
b. Extend shades 2 inches beyond sill, plus or minus 1/8 inch, if not otherwise indicated.

1) If sill extends into path of shadeband material, stop shade within 1/4 inch, plus or minus 1/8 inch, of sill

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows, unless otherwise indicated on Drawings:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances and other conditions affecting performance of the Work.

B. Verify locations of connections to building electrical system for motor-operated roller shades.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so shadeband material is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 2413

SECTION 20 0513 – COMMON MOTOR REQUIREMENTS FOR MECHANICAL

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 general requirements for single-phase and three-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors and single-phase, fan/pump-duty, horizontal, small and medium, electronically commutated, permanent magnet (EC) motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

1.4 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

1. Each installed unit's type and details.
2. Complete NEMA nameplate electrical data including design type, insulation, service factor, and efficiency
3. Diagrams of power and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.
4. Bearing type, L10 life, and seal construction (open, single, or double shielded).
5. Certification that electronic VFD driven motors comply with NEMA MG-1 Part 31.
6. Ground ring and ceramic bearing details as applicable

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Test Reports: Written reports from testing procedures outlined in Part 3.

E. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise:

1. NFPA 70: National Electrical Code.
2. NEMA Standards Publication MG 1 (2011): Motors and Generators.
3. ABMA 9: American Bearings Manufacturers Association, Load Ratings and Fatigue Life for Ball Bearings
4. UL 1004: Motors, Electric

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.

D. Product Options for Field-Installed Motors: Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated.

E. 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.

F. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:

   a. Motor controllers
   b. Magnetic controllers
   c. Multispeed controllers
   d. Reduced-voltage controllers

2. Designed and labeled for use with variable frequency drives as applicable, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.
5. Ambient and environmental conditions of installation location

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide products of the following manufacturers:

1. Reliance Electric
2. Baldor Electric Company
3. General Electric
4. U. S. Electric Motors

5. Marathon Electric
6. Toshiba Corp

2.2 MOTOR GENERAL REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Motor requirements apply to factory-installed and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.
2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
3. Motor Connections: Multiple power connections not allowed.

C. Motors Less Than 1/2 HP: Single-phase

D. Motors 1/2 HP and Larger: Three-phase.

E. Frequency Rating: 60 Hz, alternating current.

F. Voltage rating of motor shall be determined by voltage of circuit to which motor is connected:

1. 120 V Circuit: 115 V motor rating.
2. 208 V Circuit: 200 V motor rating.
3. 240 V Circuit: 230 V motor rating.
4. 480 V Circuit: 460 V motor rating.

G. Service Factor: 1.15 for open drip-proof motors; 1.0 for totally enclosed motors

H. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3,300 feet above sea level.

I. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

J. Motors shall be NEMA Design B.

K. Provide Class B insulation, unless noted otherwise.

L. All disconnects and other electrical accessories shall comply with Division 26 requirements

M. Motors shall be nominal 1,800 rpm, unless noted otherwise.

2.3 SINGLE-PHASE EC MOTORS

A. Motors equal to or smaller than 1 HP shall be Electronically Commutated (EC) type, to suit starting torque and requirements of specific motor applications.

B. Bearings: Pre-lubricated, antifriction ball bearings suitable for radial and thrust loading.

C. Motors: Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20 percent of full speed (80 percent turndown). Motor shall be a minimum of 85 percent efficient at all speeds.

1. Variable speed, 0 - 2,000 RPM.
2. Adjustable delay profile.
3. 0 - 10 volt input signal.

4. Output signal.
5. Programmable ramp rate.
6. Soft start.
7. Remote controller.
8. Moisture resistant.
9. Insulation: Class H.
10. Enclosure: Class 2, IP44.
11. Integrated motor protection (electronically protected).
12. UL 778, 1004-1, 508C.
13. CAN/CSA C22.2 #108, #100, #107.1.
14. EMC (89/366 EEC): EN 61000.
15. LVD (73/23/EC): EN 60335-1, EN 60335-2-51.
16. Machine Safety (98/37/EC): EN ISO 12100.

2.4 THREE-PHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor

B. Enclosure: Open Drip Proof (ODP) unless noted otherwise in equipment specifications or schedules, and as suitable for service and application.

C. Motor Efficiency: Nominal (nameplate) full load efficiency and corresponding minimum efficiency shall be equal to or greater than that stated in NEMA MG-1 (2011) Table 12-12 – Full Load Efficiencies of 60hz NEMA Premium Efficient Electric Motors - 600 volts or Less.

1. “Premium Efficient” for all motors 1 hp and larger, including those furnished as part of equipment specified in equipment sections. The efficiency and/or “NEMA Premium Efficiency” shall be displayed on the motor nameplate and clearly indicated on the equipment shop drawings submitted for approval.

D. Motors less than 3 HP**:** Steel or cast iron motor frames, cast aluminum, cast iron, or steel end plates, steel or cast iron terminal box, copper windings. Motor nameplates shall be steel, engraved-type, riveted to motor.

1. Bearings: Regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings, selected for a minimum L-10 bearing life of 26,280 hours, for belted and direct drive.

E. Motors 3 HP and above: cast iron motor frame and mounting feet, cast iron end plates (bells), steel or cast iron terminal box, copper windings. Motor nameplates shall be stainless steel engraved type, riveted to the motor.

1. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings. Rated for an L-10 life of 40,000 hours (belted) or 130,000 hours (direct connected).

F. Bearing life calculations shall be per ABMA 9, and for belted applications shall be based on the maximum external side load limits for belted applications per NEMA MG-1 Table 14-1A. L-10 life calculations for vertical motors and horizontal motors mounted in the vertical position shall consider the application’s thrust loading.

G. TEFC motors shall also include an external shaft slinger on drive end.

H. Multispeed Motors: Variable torque.

1. Separate windings shall be provided for each speed

I. Stator: Copper windings.

J. Rotor: Random-wound, squirrel cage.

K. Temperature Rise: Match insulation rating.

L. Insulation: Class F.

M. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

N. Motors shall not exceed dBA levels listed in NEMA MG-1 54 PART 9 Tables 9-1 and 9-3, at all speeds.

O. Motors shall be suitable for continuous duty at rated horsepower, with a maximum hot spot temperature that does not exceed the temperature limit of the insulation, when operated in an ambient temperature of 40 degrees C, except as otherwise indicated.

P. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable NEMA foundation sliding bases.

Q. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

R. For motors used with variable frequency drives, provide General Purpose NEMA Premium Efficiency Class motors complying with NEMA MG-1 Part 30 with windings that meet the requirements of NEMA MG-1 Part 31.4.4.2 and with minimum insulation of Class F.

1. For all PWM VFD driven motors: Provide a maintenance free, circumferential conductive micro fiber grounding ring installed on the AC motor to discharge shaft currents to ground. Grounding ring shall be AEGIS SGR (Shaft Grounding Ring).
2. Motors protected by the AEGIS SGR shall be warranted for the term of the manufacturer's motor warranty from induced bearing current damage.

S. Explosion Proof motors:

1. UL listed for application or duty.
2. Motors shall conform to requirements defined in Article 500, 501, 502, and 503 of the National Electric Code.
3. Motor nameplate shall be specifically marked "explosion proof."
4. Sound power levels shall not exceed recommendations of NEMA MG-1 PART 9 Tables 9-1 and 9-3, at all speeds.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

B. Install motors on concrete bases

C. Comply with mounting and anchoring requirements specified in Section 20 0548 "Vibration Controls for Mechanical."

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
2. Test interlocks and control features for proper operation.
3. Verify that current in each phase is within nameplate rating.

B. Testing: Owner shall engage a qualified testing agency to perform the following field quality-control testing should the proper performance of the motor be in question. If motor performance is found to be deficient, Contractor shall replace motor at no cost to Owner.

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.4 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

B. Verify that bearings are factory lubricated before starting motors. Lubricate per manufacturer’s instructions. Do not over-lubricate bearings.

C. Check motors for unusual heating, noise, or excess vibration during operation. Correct any such deficiencies.

1. Any motors with vibration exceeding specified limits, as noted in the Testing, Adjusting and Balancing Section, or manufacturer's recommendations, whichever is more stringent, shall be corrected, at no cost to Owner, until reduced below those limits.

3.5 MOTOR CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

3.6 MOTORS USED WITH VARIABLE FREQUENCY DRIVES

A. Install shaft grounding rings on all equipment motors using variable speed drives.

B. Install per manufacturer's instructions.

C. Assure grounding of SGR to motor frame.

END OF SECTION 20 0513

SECTION 20 0523 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. Provide valves as scheduled and specified for the following systems:

1. Cold Water, Hot Water, Hot Water Return
2. Hot Water Heating
3. Others as indicated

1.3 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1. National Sanitation Foundation NSF/ANSI-61, including Annex G (listed as ≤ 0.25% weighted average lead content) (and/or NSF/ANSI-372) and Annex F. Applies to any item in contact with domestic (potable) water.
2. U.S Safe Drinking Water Act (any item in contact with domestic (potable) water).

PART 2 - PRODUCTS

2.1 VALVE APPLICATION SCHEDULE

A. Cold Water, Hot Water and Hot Water Return System:

1. Isolation through 2": Ball valve.
2. Isolation 2 1/2" and Larger: High performance butterfly valve, all stainless steel.
3. Check: Swing check through 2", silent check for 2 1/2" and up.
4. Balancing: Manual balancing valve.
5. Specialty Valves: Refer to related sections.

B. Hot Water Heating System:

1. Isolation through 2": Ball valve.
2. Isolation 2 1/2" and Larger: High performance butterfly valve isolation.

2.2 GENERAL VALVE REQUIREMENTS

A. All valves shall have seats, stem seals and disc materials compatible with intended fluid, temperature, pressure and service.

B. All EPDM shall be peroxide cured. All wetted seals shall be made from materials that are immune from chloramine degradation.

C. Valves in contact with domestic (potable) water shall be “lead free” NSF/ANSI-61 Annex G (and/or NSF/ANSI-372) labeled. Soldered lead free valves (all types) are restricted to use on domestic potable water systems only.

D. Manually operated valves 4" and larger installed 10 feet A.F.F., or higher, shall have chain wheel operators. Chain shall reach to within 7'-0" of floor or operating platform, or within two feet of accessible ceiling.

E. Gate and globe valves shall be repackable under pressure whether open or closed.

F. Unless noted otherwise, valves shall be rated for a minimum of 125# WSP (working steam pressure)/ 250# WOG (cold water, oil, gas).

G. Unless noted otherwise, all butterfly valves shall be full lug construction, suitable for bi-directional dead end service, and have open position memory stop. Manually operated butterfly valves 4" and larger shall have enclosed worm gear operators with position indicators.

H. Provide extended valve stems for insulated piping.

I. Where the valves are installed outdoors, all components including the gear operated wheel operators shall be weatherproofed.

J. Unless noted otherwise, valves through 2" shall have screwed connections for steel piping and sweat connections for copper piping; valves 2-1/2" and larger shall be flanged.

K. Unless noted otherwise, valves shall be same size as piping.

2.3 BALL VALVE

A. Two-piece, full port, bronze body, stainless steel ball and stem, Teflon seat, plastic coated lever handle and locking devices where noted in drawings.

1. Valves for Natural Gas shall be UL or CSA approved for natural gas service.
2. Manufacturers:

   a. Watts
   b. Nibco
   c. Apollo
   d. Milwaukee
   e. Hammond
   f. Grinnell (Grinnell permitted only where grooved connections permitted)
   g. Jomar Valve model T/S-100NEG with CW511L brass alloy body and end connection and CW510L brass alloy ball and stem and T.E.A. coated ball

2.4 HIGH PERFORMANCE BUTTERFLY VALVE

A. Full lug, high performance type, carbon steel body, 316 stainless steel disc, stainless steel shaft and bearing, PTFE seat, Teflon stem packing. Rated for 150 psi, 450 degrees F.

B. Manufacturers:

1. Bray – Braylok Series 41
2. Dezurik - BHP
3. Jamesbury - 815L
4. Milwaukee - HP Series
5. Tri-Seal Valve-Contromatics (formerly Watts/KF Contromatics)
6. Xomox Pliaseal
7. ABZ ABZolute Seal Series 400

C. For domestic water systems, full lug, high performance type, 316 stainless steel body, 316 stainless steel disc, stainless steel shaft and bearing, (all wetted parts stainless steel) PTFE seat, Teflon stem packing. Rated for 150 psi, 250 degrees F.

2.5 SWING CHECK VALVE

A. Bronze body and trim.

1. Manufacturers:

a. Milwaukee model 509
b. Crane model 37
c. Grinnell model 3300
d. Nibco
e. Apollo

2.6 SILENT CHECK VALVE

A. Spring loaded type check valves, stainless steel spring, iron body, and bronze trim.

B. Manufacturers:

1. Wafer Style:

a. Milwaukee - Series 1400, APCO - Series 300, Mueller, Metraflex

2. Globe Style:

a. Milwaukee, APCO, Mueller, Metraflex, Apollo

3. Condensate pump and pressure powered pump discharge:

a. Durabula model SCV, stainless body

2.7 DRAIN VALVE

A. General Service: Ball valve with 3/4-inch hose threaded end fitting and cap.

2.8 MANUAL BALANCING VALVES

A. General Manual Balancing Valve Requirements: ports for measuring flow, memory stop, bubble tight shut-off, valve Cv characteristics suitable for throttling. Size valve to produce readable design flow and maximum full open pressure drop of 3 feet.

B. Through 2": bronze body, brass ball, calibrated.

1. Manufacturers:

a. Bell & Gossett Circuit Setter Plus
b. Armstrong
c. Flow Design Inc.
d. TACO
e. T&A

C. Valves 2-1/2" and Larger: cast iron body, brass ball or bronze disc, TFE seat rings, bronze seat, and stainless steel stem.

1. Manufacturers:

a. Bell & Gossett Circuit Setter
b. Armstrong
c. Flow Design Inc.
d. TACO
e. T&A

D. Venturi Style: bronze body, brass ball, and venturi flow measuring station.

1. Manufacturers:

a. Preso B Plus
b. Accusetter

E. Provide gauge kit for projects requiring over 20 balancing valves. Gauge kits shall be capable of directly reading GPM, or shall include conversion chart from Cv and pressure.

2.9 SOLENOID VALVES

A. Full port, bronze body, malleable iron coil enclosure, stainless steel plunger, valve stem, bonnet tube, and spring, Buna-N seal, rated for 500 psi. See drawings for voltage, size and position (NC or NO).

1. Manufacturer:

a. Magnetrol Figure No. 200-A
b. ASCO
c. Skinner

PART 3 - EXECUTION

3.1 GENERAL VALVE INSTALLATION REQUIREMENTS

A. Install valves such that operator is completely operable, and the valve position indicator is discernible from the floor.

3.2 SOLENOID VALVE INSTALLATION REQUIREMENTS

A. Provide a strainer before each control or solenoid valve. Provide a water hammer arrestor upstream of solenoid valves used for domestic water service.

3.3 DOMESTIC HOT WATER VALVE INSTALLATION

A. For general service applications: domestic hot water flanged valves shall be installed with 100% PTFE gaskets, Interlex SQ-S.

END OF SECTION 20 0523

SECTION 20 0529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Equipment supports.

B. Related Sections:

1. Division 20 Section "Pipe Expansion Joints".
2. Division 20 Section "Vibration Controls for Piping and Equipment".

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Provide all necessary hangers, rods, supports, concrete inserts, etc., and proper size angles, channels, or unistruts to support all piping in a manner allowing movement during expansion and contraction. These supporting structures shall not be overstressed. All piping shall be supported with approved hangers designed for vertical adjustment and capable of carrying normal loads in all conditions of operation.

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for the following. Include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

1. Clevis.
2. Fee and Mason.
3. Anvil.
4. PHD Manufacturing, Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of hot dip galvanized or cadmium plated.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. PHS Industries, Inc.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled thermal 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.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. 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 (DN 65) 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.

H. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.

I. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.

J. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with suitable vibration isolation units to eliminate noise transmission between the piping and the building structure.

K. Hanger components shall not be used for purposes other than for which they were designed.

L. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

M. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.

N. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roller carriages shall be used.

O. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4".

P. Loads Hung from Cold Formed Roof Trusses: Attachments shall be made to truss chord members only. Connections shall be consistent with details published by truss supplier. All hanging methods must be submitted for approval. Distribute piping and equipment loads so as not to exceed allowable truss loading. Coordinate hanging with other trades to uniformly distribute loads on structural members.

Q. On a riser subject to expansion, only one support of the rigid type shall be used.

R. Riser clamps shall have a positive means of engagement between the pipe and the clamp.

S. Provide anchors, guides and restraints wherever necessary to support risers, to maintain pipe in position, and to properly distribute expansion.

T. Provide supplemental framing, angles, channels and beams where the anchor locations do not align with the building structure or where the intended loads exceed the structural framing maximum load carrying capacity.

U. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

V. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

W. Insulated Piping:

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 allowed by 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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 (40 mm).

3.4 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use only circular cross-section rod hangers to connect to building structural attachments to pipe support devices. Rod couplings are not acceptable.

D. Use of “C” clamps and beam clamps of “C” pattern and any modifications thereof is prohibited.

E. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

F. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

G. Use carbon-steel pipe hangers and supports and attachments for general service applications.

H. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for outdoor applications.

I. Use copper-plated pip hangers and copper or stainless-steel attachments for copper piping and tubing.

J. Use padded hangers for piping that is subject to scratching.

K. Use thermal-hanger shield inserts for insulated piping and tubing.

L. 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 (DN 15 to DN 750).
2. Adjustable , Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe bas stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
6. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
8. Pipe roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
9. Adjustable Pipe Roll and Base Units (MSS Type 46): for support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

M. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) in longer ends are required for riser clamps.

N. 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 (150mm) for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

O. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Side-Beam or Channel clamps (MSS type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21: For attaching to center of bottom flange of beams.
4. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
5. Linked-Steel Clamps with Eye nuts (MSS type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
6. Malleable-Beam clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

P. 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.

Q. 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 Type48): For light loads if vertical movement does not exceed 1-1/4 inches (32mm).
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 system.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow 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 allow 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 allow 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.

R. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

S. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 20 0529

SECTION 20 0548 – VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. Provide vibration control items for isolating vibration of mechanical equipment, piping and ductwork.

B. Provide all hangers, isolators, bases, pads, sleeves and other devices specified, required, or detailed for the project. Include all vibration isolation system elements as recommended by the equipment manufacturer's representative to make a complete, correct and safe installation. Supply and install all incidental materials needed.

1.3 QUALITY ASSURANCE

A. Work of this section shall be performed by skilled workers who are experienced in the necessary crafts to meet the requirements of this Section.

B. Provide field supervision and inspection to assure proper installation, adjustment and performance. Replace any isolators that are found to resonate with the supported equipment.

C. As a minimum provide vibration control per ASHRAE - 2015 - HVAC Applications, Chapter 48 - "Sound and Vibration Control".

D. Isolators shall be selected, installed and adjusted to prevent the transmission of objectionable vibration and noise to the building structure.

E. The size and number of mounts and hangers shall be chosen to meet these specifications, even if not specifically shown on the plans. Brackets, rails, bases, braces, etc., shall be provided as needed for a complete and correct installation.

1.4 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers for products specified in this Section shall be one of the following:

1. Vibration Eliminator Company
2. Mason Industries, Inc.
3. Kinetics Noise Control
4. Vibration Mounting and Controls (VMC)

PART 2 - PRODUCTS

2.1 FLEXIBLE DUCT CONNECTIONS

A. Flexible sleeves for duct connections shall be fabricated from flexible, airtight, coated fabric. Each sleeve shall be installed with at least 3 inches slack across a clear metal to metal gap of at least 4 inches. That is, 7 inches of this fabric is required for each sleeve.

2.2 FLEXIBLE PIPE CONNECTORS

A. Flexible connectors for pipes shall be neoprene Mason Type MFNC, MFTNC or as approved.

2.3 FLEXIBLE METAL HOSE CONNECTORS

A. Length and end fittings as shown in drawings, with an inner corrugated hose made of type 304, 321, or 316 stainless steel and outer braid made of 304 stainless steel.

1. Manufacturers:

   a. Metraflex
   b. Flex Hose Co.
   c. Flexonics
   d. Mason

B. For copper piping systems, use copper construction braided hoses.

1. Approved Manufacturers:

   a. Anaconda
   b. Flex Hose Co.
   c. Flexonics
   d. Mason
   e. Metraflex

2.4 FLEXIBLE CONNECTORS (RUBBER):

A. Flexible connectors with neoprene and nylon type elements, with carbon steel or ductile iron floating flanges. Rated for 150 psig working pressure at 200ºF, with peroxide cured EPDM liner and cover, ultraviolet resistant, hand wrapped, non-molded, multiple arch body, with control rods or cables. Approved Manufacturers: Mason Industries, Inc. Type SFDEJ, Mercer Rubber Co., Metraflex Type DS.

2.5 VIBRATION ISOLATORS

A. The static deflection of isolators shall be as specified below and in ASHRAE - 2015 Chapter 48.

B. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.

C. Provide vibration isolator types as indicated in the table in section 3.2.

D. Isolator Mount - Type 1:

1. Type 1(Waffle Pads) shall be 3/8 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
2. If the isolator is bolted to the structure, a neoprene mounting sleeve shall be installed under the bolt head between the steel washer and the base plate.
3. Mason Industries Type Mini Super W or approved equal.

E. Isolator Mount - Type 2:

1. Type 2 (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have a leveling bolts rigidly secured to the equipment.

2. The isolator shall be manufactured with bridge bearing quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.
3. Mason Industries Type ND or approved equal.

F. Isolator Mount - Type 3:

1. Type 3 (Spring and Low Dynamic Stiffness Mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
2. Unless otherwise specified, the minimum static deflection of Type 3 isolators for equipment mounted on grade slabs shall be 1 inch and for the minimum static deflection for equipment mounted above grade level shall be 2 inches.
3. Two Type 3 isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bounded to the isolator baseplate.
4. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene mounting sleeve shall be installed under the bolt head between the steel washer and the base plate.
5. Mason Industries Type SLF or approved equal.

G. Isolator Hanger - Type 2:

1. Type 2 (Double Deflection Low Dynamic Stiffness Hangers) shall consist of a molded low dynamic stiffness (LDS) isolating element in a steel hanger box. A LDS sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30° arc. When installed, the hanger box shall be allowed to rotate through a full 360° without encountering any obstructions.
2. The isolator shall be manufactured with quality LDS and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of Type 2 hangers shall be minimum of 0.3 inches.
3. Mason Industries Type HD or approved equal.

H. Isolator Hanger - Type 3:

1. Type 3 (Spring and Low Dynamic Stiffness Hangers) shall consist of a steel spring in a series with a low dynamic stiffness (LDS) isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
2. Unless otherwise specified, the static deflection of SPH hangers shall be 2 inches.
3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30° arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed the spring element shall not be cocked and the hanger box shall be allowed to rotate through a full 360° arc without encountering any obstructions.
4. Mason Industries Type 30N or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All equipment mounted on vibration isolators shall have a minimum operating clearance of 1 inch between the bottom of the equipment or inertia base (and height saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment.

B. Check the clearance to ensure that no scraps have been left to short circuit the vibration isolators.

C. Provide a minimum of 4 inches between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

D. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes, or ductwork installed on vibration isolators.

E. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Equipment should be blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

F. All mechanical equipment not specifically identified in this specification that contains rotating or vibrating elements shall be installed on Mount Type 2 neoprene isolators as appropriate. Provide supporting steel structure between isolators and equipment if isolator does not readily connect to equipment.

G. All equipment and their respective isolators shall be directly mounted on primary steel. Units and isolators shall not be mounted on resiliently supported steel cabinets or plenum floors or other flexible construction.

H. Roof mounted fans shall be installed on a curb mounted base.

I. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36 inch long flexible conduit. Coordinate wiring connections with the Electrical Installer.

3.2 APPLICATION TABLES

A. Suspended Equipment

Equipment Type	**Isolator Type**
Pumps:	
In Line Pumps < 5 HP	Hanger 3
Fans:	
< 22" Dia	Hanger 2
> 22" Dia & < 2" SP	Hanger 3
> 22" Dia & > 2" SP	Hanger 3

"Floor Span": Defined as the distance between centers of floor joists

3.3 FAN ISOLATION - GENERAL

A. All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

3.4 PIPES WITH MULTIPLE CONNECTIONS

A. Where a pipe run connects multiple items of equipment in the Mechanical Room the pipe hanger isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

3.5 INSPECTION

A. Isolator manufacturer service representative shall inspect and approve the installation of the vibration isolators and shall submit a report to the Owner which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification and model or type.

B. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

END OF SECTION 20 0548

SECTION 20 0553 – MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

1.2 SCOPE OF WORK

A. Mechanical identification on piping, ductwork and equipment, identification of underground pipe, valve tags, and architectural access panels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 for lettering, size, colors, and viewing angles of mechanical identification.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide mechanical identification materials from one of the following:

1. Brady Co.
2. Brimer
3. Craftmark
4. Seton
5. Marking Services Incorporated

PART 2 - PRODUCTS

2.1 PIPE MARKERS

A. Manufacturer's standard, pre-printed, color-coded, plastic pipe markers, complying with ANSI A13.1, and requirements below. Self-adhesive markers are not acceptable.

B. For pipe diameter (with insulation) less than 6": full-band, semi-rigid, snap-on pipe markers, extending 360 degrees around pipe.

C. For pipe diameter (with insulation) of 6" and larger: full-band or strip-type pipe markers, but not narrower than 3 times letter height. Fasten with nylon or stainless steel bands for pipe 6" through 12". Fastened with stainless steel bands for piping over 12".

D. Lettering: Standard nomenclature which best describes piping system, as selected by Engineer (in cases of variance from table below).

E. Arrows: Pipe marker arrows indicating direction of flow, either integrally with piping system lettering, or as a separate marker.

F. Identify contents of piping by both fluid contained and unique temperature and /or pressure (if necessary to distinguish between other systems with same fluid at different conditions); e.g. Potable Hot Water - 110F vs Potable Hot Water - 140F.

G. Use the following color coding and nomenclature for pipe markers:

Plumbing and Waste Pipe System Labels	Drawing ID Letter (For Reference Only)	Letter and Label Color
Cold Water, Potable	CW	White on Green
Fire Protection	FP	White on Red
Hot Water Supply, Potable	HW	Black on Yellow
Hot Water Return, Potable	HWR	Black on Yellow
Rainwater Conductor	RC	White on Green
Sanitary Vent	V	White on Green
Sanitary Waste	SAN	White on Green
Storm Sewer Water	ST	White on Green

Heating Pipe System Labels	Drawing ID (For Reference Only	Letter and Label Color
Hot Water Heating Return	HWHR	Black on Yellow
Hot Water Heating Supply	HWHS	Black on Yellow

ALL labeling shall conform to NFPA 99.

2.2 DUCT MARKERS

A. Plastic, adhesive type color-coded duct markers, with arrow indicating direction of flow, and with fan system identified. Conform to the following color code and nomenclature:

Service/Duct Label	Drawing ID (For Reference Only)	Letter and Label Color
Exhaust Air (Equip.#)	EX (Eq.#)	Black on Yellow
Outdoor Air (Equip.#)	OA (Eq.#)	White on Green
Return Air (Equip.#)	RA (Eq.#)	White on Green
Supply Air (Equip.#)	SA (Eq.#)	White on Green

B. Provide plastic adhesive duct access door markers indicating item and associated equipment accessed, and appropriate safety and procedural information (e.g. Fire Damper AHU-1).

2.3 EQUIPMENT MARKERS

A. Engraved plastic equipment markers for all scheduled equipment, (e.g., chillers, pumps, air handling units, heat exchangers, and fans). Indicate drawing I.D., and service, (e.g., EF-1 serving FH No.3 in Rm. 2035, or P-7 Primary Chilled Water), nominal capacity (tons, cfm or gpm). Scale marker and lettering to equipment labeled. Typical nomenclature:

Drawing I.D. and Equipment Label	Equipment
|	
AHU	Air Handling Unit
CH	Chiller
CHWP	Chilled Water Pump
CP	Condensate Pump
CUH	Cabinet Unit Heater
DAC	Dental Air Compressor
DVAC	Dental Vacuum Pump
DWH	Domestic Water Heater

Drawing I.D. and Equipment Label	Equipment
GEF	General Exhaust Fan
HWB	Hot Water Boiler
HWHP	Hot Water Heating Pump
KEX	Kitchen Hood Exhaust Fan
P	Pump (other than those listed)
RF	Return Fan
SF	Supply Fan
TEC	Terminal Equipment Controller
UH	Unit Heater
VAV	Variable Air Volume Box (with corresponding AHU No.)

2.4 IDENTIFICATION ACCESSORIES

A. Valve Tags: 1-1/2" diameter brass valve tags with 1/4" stamp-engraved designations with piping system abbreviation and sequenced valve numbers. Provide solid brass chain, or solid brass S-hooks of the size and type required for proper attachment of tags to valves.

B. Architectural Access Panel Markers: 1/16" thick engraved plastic laminate, with nomenclature corresponding to items for which access door was installed (eg. VAV-7, TEC-7 and HWH control valve V-23).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Install identification after insulation is applied. Protect identification from paint, or apply after painting is complete. Install above ceiling identification prior to acoustical ceilings.

B. Attachment: Securely attach all mechanical identification to associated pipe, duct, panels and equipment. Locate identification to be readily visible.

3.2 PIPING SYSTEM IDENTIFICATION

A. Install pipe markers on all piping systems in all locations where piping, whether concealed or non-concealed, and where accessible at manholes and access panels. Installed at all access panels or doors, adjacent to valves and branch connections, both sides of floors, ceilings and walls, and all major changes in direction,

B. Locate pipe markers near points where piping continues into shafts, underground, floor or wall; at 25' spacing along exposed runs (15' in congested areas), at valves, equipment and control devices, and where there could be question of flow pattern.

C. Install marker over pipe insulation segment on hot non-insulated pipes.

3.3 DUCTWORK IDENTIFICATION

A. Install duct markers on all supply, return, exhaust, intake and relief ductwork, whether concealed or non-concealed, , and where accessible at access panels. Install at all access panels or doors, both sides of floors, ceilings and walls, and all major changes in direction.

B. Locate duct markers near points where ductwork originates or continues into shafts, floor or wall, and at 25' spacing along exposed runs (15' in congested areas), equipment and control devises, and where there could be a question of flow pattern.

C. Install duct access door markers on all access doors.

3.4 EQUIPMENT IDENTIFICATION

A. Provide equipment markers on scheduled equipment.

3.5 VALVE IDENTIFICATION

A. Install valve tags on all new valves and regulators for the following piping systems, except for valves within factory-fabricated equipment, at plumbing fixture faucets, hose bibs, and valves located directly at the equipment served. Number valves in a logical sequence relative to location installed.

B. List each tagged valve in valve schedule for each piping system. Include a copy of the valve tag schedule in the Operation and Maintenance manuals.

END OF SECTION 20 0553

SECTION 20 0719 – MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. Insulate piping, ductwork and equipment unless indicated as not to be insulated in paragraph 1.3.

B. Repair or replace insulation damaged during construction.

1.3 ITEMS NOT TO BE INSULATED

A. Equipment: Factory insulated equipment.

B. In hot piping: Unions, flexible connectors, control valves 2" and smaller, safety valves, discharge vent piping, vacuum breakers, thermostatic vent valves.

C. Other piping: waste and vent, refrigerant liquid lines, vertical portion of rain water conductors.

D. Ductwork: indoor return air ductwork in conditioned areas, exhaust air ductwork (unless called for on drawings and as indicated below).

E. Indoor relief or exhaust ductwork between damper and louver shall be insulated.

PART 2 - PRODUCTS

2.1 GENERAL INSULATION DEFINITIONS

A. Insulation thermal conductivity: No greater than value listed, in Btu-inch/hour-square foot-degrees F at 75 degrees F mean temperature.

B. Water Vapor Permeance (ASTM E97 or E96, Procedure A): No more than value listed, in perms. Water vapor permeability (ASTM C355): No greater than value listed, in perm-inch.

C. Puncture resistance (ASTM D781): No less than value listed.

D. Flame spread classification (ASTM E84, NFPA 255): No greater than value listed. Smoke density classification (ASTM E84, NFPA 255): No greater than value listed. Composite listing includes insulation, jacket, and adhesive.

E. Density no less than value listed, in pounds per cubic foot.

2.2 PIPING INSULATION THICKNESS TABLE

A. Minimum insulation thickness in inches, shall comply with the table below for the associated piping system and pipe sizes. Values are based on an R value of 4 per inch thickness. Overall conductance shall comply with ASHRAE 90.

Piping System Fluid	Temp. Range (Deg. F)	Thickness in Inches for Pipe Sizes Through Size Listed					
		< 1 1/2”	1 1/2 thru 3”	4”	6”	8”	10” and Above
Domestic Hot Water and Recirc	110-220	1.0	1.5	1.5	1.5	1.5	1.5
		(above includes domestic and heating)					
Domestic Cold Water	Any	0.5	1.0	1.5	1.5	1.5	1.5
Storm	Any	0.5	0.5	0.5	0.5	0.5	0.5
Heating Hot Water	Any	1.5	2.0	2.0	2.0	2.0	2.0

2.3 PIPING INSULATION - INDOOR (FIBERGLASS)

A. Insulate with fiberglass insulation with factory-applied vapor barrier jacket with self-sealing laps. ASTM C547 Class 1 insulation, conductivity of 0.26. Vapor barrier jacket: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.2 perms, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50. Apply insulation in thickness listed in Insulation Thickness Table listed in paragraph 2.2.

1. Manufacturers:

   a. Johns-Manville (Micro-Lok 650 AP-T)
   b. Knauf (ASJ-SS1 Pipe Insulation)
   c. Owens/Corning (Fiberglass ASJ/SSL-II)

B. At fittings and flanges, insulate with wrapped fiberglass insulation of same thickness as adjacent pipe, and cover with pre-molded PVC jackets. Seal edge of jacket with self-sealing vapor barrier tape.

1. Jacket Manufacturer:

   a. Zeston
   b. Ceeco
   c. Proto

C. For valves, strainers, suction diffusers and other accessories that require maintenance: In hot piping, insulate similar to fittings and flanges. In cold piping, insulate with closed cell elastomeric insulation, installed to be removable for maintenance access.

D. Wherever necessary to seal insulation and provide a complete and continuous vapor barrier, apply two coats of insulating mastic

1. Manufacturers:

   a. Celotex - MW-1 Insulating and Finishing Cement
   b. Pabco - Pabcote One Coat Insulating Cement

2.4 PIPING INSULATION (CLOSED CELL ELASTOMERIC)

A. As a Contractor's Option to paragraph 2.3, insulate hot water, cold water, chilled water, refrigerant, piping systems with flexible closed cell elastomeric or Polyolefin pipe insulation, ASTM C534, conductivity of 0.30, water vapor permeability of 0.20. In thickness 1" and less, composite flame spread/ smoke density of 25/50.

1. Manufacturers:

a. Armstrong - AP Armaflex
b. Rubatex - R-180-FS
c. IMCOA.

B. Insulate hot water, cold water, chilled water, and refrigerant piping systems with flexible closed cell elastomeric or Polyolefin pipe insulation, ASTM C534, conductivity of 0.30, water vapor permeability of 0.20. In thickness 1" and less, composite flame spread/ smoke density of 25/50.

1. Manufacturers:

a. Armstrong - AP Armaflex
b. Rubatex - R-180-FS
c. IMCOA

2. Apply insulation in thickness listed in table in paragraph 2.2. Seal all butt joints and seams by joining cut edges with adhesive as supplied by the insulation manufacturer.

2.5 DUCTWORK INSULATION - INDOOR, CONCEALED

A. In ceiling spaces, building shafts, and other locations where not visible, insulate ductwork with 1-1/2" thick, blanket-type, fiberglass insulation with factory-applied vapor barrier, and 2" stapling and taping flange along one edge. Insulation: ASTM C553, density of 0.75, conductivity of 0.32. Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

B. Manufacturers:

1. CertainTeed - Type 75 FSK Standard Duct Wrap
2. Schuller - R Series Microlite with FSKL;
3. Knauf - Duct Wrap with Multi-Purpose FSK
4. Owens/Corning - All Service Faced Duct Wrap

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. All systems shall be tested and approved before being insulated.

B. The insulation shall be applied over clean, dry surface.

C. Insulate all valves, flanges, couplings and fittings. Valve and flange insulation shall be removable and reinstallable.

D. Full lengths of insulation shall be used except at end of straight sections and as required to accommodate fittings. Insulation shall be applied with the joints tightly fitted together. Cracks or voids shall be filled with insulation. Manufacturer's recommended installation procedures shall be strictly adhered to.

E. The edges and seams at all visible locations shall be finished in a neat and workmanlike manner.

F. All exposed ductwork insulation shall be applied with edges butted. Insulation shall be impaled over stick clips or pins welded to the duct, and secured with speed clips. Spacing of pins shall be as required to hold insulation firmly in place but not less than one pin per square foot. All joints and penetrations of the vapor barrier shall be sealed with a 3" wide strip of the same material, supplied with vapor barrier adhesive to both surfaces as recommended by adhesive manufacturers.

G. Blanket insulation shall be tightly sealed at all joints and seams. Insulation shall be cut longer than ductwork perimeter to allow maximum thickness on all areas and avoid excessive compression. All joints shall be over lapped at least 2" and stapled in place. The stapled seams shall be sealed with a minimum 3" wide pressure sensitive tape designed for use with the duct insulation. All breaks in the vapor barrier facing shall also be sealed with the tape. The underside of ductwork 18" or greater in width, and vertical surfaces 48" or greater shall have the insulation additionally secured with mechanical fasteners and speed clips spaced approximately 12" on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above.

H. Finished installation shall provide a continuous and effective vapor barrier.

END OF SECTION 20 0719

SECTION 20 1113 – PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, in particular the Related Sections listed below, apply to this Section.

B. Related Sections

1. Section 20 0500 - Common Work Results for Mechanical
2. Section 20 0548 - Vibration Control

1.2 SUMMARY

A. This Section specifies piping materials and installation methods for the piping systems listed in Part 2 and includes joining materials, piping specialties, and basic piping installation instructions.

1.3 SUBMITTALS

A. Product Data: Include manufacturer, catalog illustrations, model, rated capacities, performance, dimensions, component sizes, rough-in requirements, materials of construction, and operating and maintenance clearance requirements. Additionally include:

1. Provide a piping material schedule that indicates, by service, pipe material, pipe manufacturer, fitting type and manufacturer, joint type and manufacturer.
2. Solder and brazing material data sheets.
3. Data sheets for all products listed in this section including flanges, gaskets, unions, hangers, di-electric protection method, thermal hanger shield inserts, di-electric fittings, flexible metal hose, flexible connectors, and seal sleeve systems.

1.4 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1. All piping, unless noted otherwise, shall comply with ANSI Standard B31.9 - Building Service Piping.
2. National Sanitation Foundation NSF/ANSI-61, including Annex G (listed as ≤ 0.25% weighted average lead content) (and/or NSF/ANSI-372) and Annex F. Applies to any item in contact with domestic (potable) water.
3. U.S Safe Drinking Water Act (any item in contact with domestic (potable) water)
4. Mill certifications indicating country of origin and compliance to ASTM/ANSI/NSF and other required compliance standards verified by independent third party based in the United States, shall be promptly provided whenever requested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store piping materials and accessories raised off the floor or ground on pallets and protected with coverings to prevent damage or contamination due to weather and construction activities. Provide temporary protective caps on pipe ends. Maintain caps installed at all times until just prior to assembly, and recap open pipe ends at the conclusion of each work day. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

1.6 WARRANTY

A. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL PIPING REQUIREMENTS

A. All piping materials shall be compatible for temperature, pressure and service.

B. All wetted seals shall be made from materials that are immune from chloramine degradation.

C. Provide long radius elbows and returns on welded steel pipe.

2.2 PLUMBING PIPING SYSTEMS

A. Domestic Cold Water, Hot Water and Hot Water Return - Above Ground (including non-potable):

1. For piping through 6”:

a. Pipe: Type L Copper, hard drawn, ASTM B88
b. Fittings: Wrought Copper, ANSI B16.22
c. Joints: Soldered through 2”; Brazed for 2-1/2” through 6”

B. Sanitary Waste and Vent - Above and Under Ground:

1. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM A888

a. Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
b. Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings

C. Storm - Above Ground:

1. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM A888

a. Fittings: Cast Iron, drainage pattern, ASTM-A74, ASTM C564
b. Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings

2.3 HYDRONIC PIPING SYSTEMS

A. Hot Water Heating - Above Ground:

1. For piping through 4”:

a. Pipe: Type L Copper, hard drawn, ASTM B88
b. Fittings: Wrought Copper, ANSI B16.22
c. Joints: Soldered through 2”; Brazed for 2-1/2” through 4”

2.4 PIPE JOINTS

A. Soldered Joints: ASTM B32; Alloy Sb5, (95% Tin, 5% Antimony, maximum 0.20% Lead). When recommended by the component manufacturer, use manufacturer's recommended flux. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Engelehard "Silverbrite 100", Harris "Bridgit"

B. Brazed Joints: ASTM B32, silver brazed joints with 1000F minimum melting point, conforming to AWS - A5.8, "Specification for brazing filler metal". Classification BAg-1. For domestic potable water applications, maintain a nitrogen purge during brazing to prevent deposit formation inside the pipe. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Lucas-Milhaupt Inc. "Sil-Fos", J.W. Harris "Stay-Silv 15" and "Safety Silv"

C. Screwed Joints: Tapered thread, ASME B1.20.1, joined with compatible compound or sealant tape applied to male thread only.

D. Welded Joints: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Pipe and fittings shall be beveled and butt welded.

E. Flanged Joints:

1. Select flange and gasket materials to suit service of piping and to comply with the respective ASME B31.1 or B31.9 piping standard.
2. For steel pipe, provide raised face ANSI B16.5 compliant steel flanges.
3. For copper pipe, provide Class 150 flat face ANSI B16.24 cast bronze flanges, brazed to the copper tube.

    a. Alternative: Copper companion flange by CTS Fabrication USA rated 450 PSI minimum working pressure from -66ºF to 272ºF. ANSI B16.5 compliant, powder coated, with an EPDM insulator adhered to the plate steel flange protruding inside of the flange to prevent contact with the copper companion flange adapter. Flange adapter shall be manufactured to ASME B16.22, brazed to the copper tube.

4. Gaskets shall conform to respective ANSI Standards, A21.11, B16.20, B16.21. Gaskets in steam and condensate lines shall be "FLEXTALLIC", 316 L stainless steel with "FLEXICARB" filler. Flange gaskets for domestic hot water shall be 100% PTFE. For butterfly valves on replaceable seat side with interfering set-screws, provide Garlock Style 9800.
5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Central Power Plant and Tunnels: Provide ASTM A193 B7 bolts and studs with ASTM A194 grade 2H heavy hex nuts.

F. Hubless Joints for Cast Iron No-Hub Pipe: Heavy duty ASTM C1540 couplings with stainless steel shield with stainless steel bands and tightening devices, ASTM C564 rubber sleeve with integral center pipe stop.

1. When connecting cast iron no-hub pipe to dis-similar pipe: Provide ASTM C1460 couplings specifically designed for both pipe types, with stainless steel shield with stainless steel bands and tightening devices, with ASTM C564 rubber sleeve with integral center pipe stop. Unshielded couplings shall not be used. *Connections between dis-similar pipe materials shall be restrained.* Submit coupling and restraint methods for approval.
2. Approved Manufacturers:

    a. Anaco/Huskey
    b. Clamp-All Corp.
    c. Ideal Tridon
    d. Mission Rubber Company (MCP Industries Inc.)

G. Solvent Cement Joints: Select materials suitable for pipe materials joined and compatible with fluid served. Conform to respective ASTM Standards D-2235, D-2564, D-2855 and D-3138.

H. Gasket Joint Lubricant - for use with hubless joints: Provide manufacturer's recommended gasket lubricant.

2.5 UNIONS

A. Unions in steel piping systems shall be malleable iron with ground joints made between two bronze inserts.

B. Unions in copper piping systems shall be wrought copper or brass with sweat ends.

2.6 PIPE HANGERS AND SUPPORTS

A. Provide adjustable type pipe hangers, supports and accessories for the proper support of all piping. See details on drawings for requirements. Figure and model numbers specified on drawings are for Anvil International, and Pipe Shields Inc. Equivalent products by Carpenter & Paterson, Cooper B-line and PHD Manufacturing are also acceptable. Continuous threaded rod shall be used for intermediate attachments.

B. Dielectric protection for hangers and supports: Where copper piping is supported with steel hangers and supports, dielectric protection must be provided. Use one of the following means as applicable:

1. Coated hangers (copper or plastic coating)
2. Insulation inserts
3. Cushion clamps
4. Other as approved by Engineer.

2.7 THERMAL-HANGER SHIELD INSERT ASSEMBLIES

A. Except as noted, thermal hanger shield "insert" assemblies shall be used on all insulated pipe systems at each horizontal support, and at each clamped or guided vertical support. Manufactured units shall comply with MSS SP-58 standards and be tested per MSS SP-89 guidelines. Each assembly shall closely fit the various pipe diameters and match the outside diameter of the adjoining pipe insulation. Provide pre-grooved inserts when piping is heat traced. Compressive strength shall be adequate to prevent deformation at the project's hanger spacing requirements, with a minimum 3:1 safety factor.

B. Thermal hanger shield insert assembly: Water-repellent treated, ASTM C 533, Type I calcium silicate, asbestos free insert. With G-90 galvanized sheet metal shield. With attached vapor barrier, where indicated. Each component shall have an ASTM E84 flame/smoke rating maximum of 25/50.

C. Inserts for Cold Piping (piping conveying materials less than or equal to 60F), including all chilled water and domestic cold water piping: Insert with an attached vapor barrier.

1. Provide insert and sheet metal shield covering entire circumference of pipe.

D. Inserts for Hot Piping (piping conveying materials at more than 60F): Insert only.

1. For clevis or band hangers that support pipe from bottom: Insert and sheet metal shield shall cover lower 180 degrees of pipe, or entire circumference of pipe.
2. For trapeze hangers or clamped pipe: Insert and sheet metal shield shall cover entire circumference of pipe.

E. Inserts for piping less than 3/4-inch diameter: Not required except for piping conveying materials less than 45ºF.

F. Minimum Compressive Strength of Insert Material:

1. 100 psig for sizes smaller than NPS 6.
2. 600 psig for sizes NPS 6 and larger.

G. Insert Length: Extend 2 inches beyond sheet metal shield.

H. Vapor barrier: meeting ASTM C1136, with 0.02 perms maximum water vapor permeance.

I. Adhesives shall comply with NFPA 90-A.

J. Sheet Metal Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
2. NPS 4: 12 inches long and 0.06 inch thick.
3. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick
4. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick
5. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick

K. Manufacturers

1. Cooper B-Line
2. Pipe Shields Inc.
3. Rilco Manufacturing Company
4. Value Engineered Products.
5. American Mechanical Insulation Sales

2.8 PIPE SLEEVES

A. Furnish and set pipe sleeves per details on drawings.

2.9 DIELECTRIC FITTINGS

A. For pipe 2 inch and less: Provide brass coupling. (Dielectric unions are not acceptable).

B. For pipe 2-1/2 inch and larger: Provide flange union with dielectric gasket and bolt sleeves. On copper pipe, copper companion flanges by CTS Fabrication USA may be used.

C. Dielectric waterways are prohibited for all joint systems.

2.10 STRAINERS

A. Body shall be bronze, cast steel or cast iron, to match piping materials. Strainers shall be same size as piping, with screwed connections on piping 2” and smaller, and flanged connections on piping 2-1/2” and larger. Where grooved piping is specified, grooved joint strainers may be used. Screen free area shall be a minimum of twice the internal cross sectional area of the piping where installed. Pressure rating shall be that of piping system, minimum Class 125. Provide 3/4” ball valve blow down with hose end connection on all strainers 2” and larger.

B. For water service, screen material stainless steel, with maximum openings of 1/32 (0.031) inches for pipes 2” and smaller and 3/64 (0.047) inches for pipe sizes 2-1/2” and larger.

C. Approved Manufacturers: Armstrong, Anvil International, Keckley, Metraflex, Mueller, Spirax-Sarco, Victaulic, Watts, Yarway.

2.11 FLEXIBLE PIPING CONNECTORS

A. Refer to Related Section 220548 - Vibration Control.

2.12 PIPE ANCHORS

A. Provide pipe anchors where required or shown and as detailed on drawings.

2.13 PIPING TRANSITIONS

A. For transitions between ductile iron pipe and other pipe materials, refer to the requirements for hubless joints found elsewhere in this specification.

B. When two different pipe materials must be joined such as cast iron, clay, steel, copper or plastic, provide transition fittings specifically designed for that purpose and that are manufactured in compliance with the standards relevant for the pipes joined. Transitions shall have equal corrosion resistance to the pipes joined.

C. For dissimilar metal connections, see “Dielectric Fittings”.

2.14 SLEEVE-SEAL SYSTEMS

A. Approved Manufacturers:

1. EnPro Industries “Link Seal”
2. Advance Products & Systems, Inc.
3. Metraflex Company (The).
4. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve. Shall provide a water-proof seal between the pipe and sleeve at up to 20 psig head pressure. Each link and pressure plate shall include permanent identification of size and manufacturer's name. Manufactured in an approved ISO-9001:2000 facility.

C. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe.

D. Pressure Plates: Molded of glass reinforced nylon.

E. Connecting Bolts and Nuts: Mild steel with a 60,000 psi minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B-633 and Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test. Of length required to secure pressure plates to sealing elements.

F. Sleeves:

1. Galvanized steel, ASTM A53/A53M, Schedule 40, with plain ends and welded steel collar, zinc coated. Steel Sleeve sizes 12” and larger shall be 0.375” thick or standard pipe wall thickness. Sleeves through wall shall be cast in place and the pipe shall be installed centered in the sleeve. Provide 2” collar (water-stop) of steel to match sleeve, welded all around on both sides to the sleeve at the point on the sleeve that positions it at the mid-point of the structural wall when the sleeve is in place.
2. Molded non-metallic high density polyethylene sleeves (HDPE) with integral hollow, molded water-stop ring four inches larger than the outside diameter of the sleeve itself. End caps and reinforcing ribs, manufactured in an approved ISO-9001:2000 facility. With nailer flange.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATION REQUIREMENTS

A. Work shall be done in accordance with applicable ordinances and codes. Arrange for inspections.

B. For domestic potable water applications, maintain a nitrogen purge during brazing to prevent deposit formation inside the pipe, so that the inner pipe surface remains clean. Properly ventilate the area outside the pipe to avoid unsafe levels of nitrogen.

C. Install pipe components and joining systems in accordance with the manufacturer's installation instructions.

D. Install piping to permit complete draining. Provide capped hose end ball type drain valves at all low points.

E. Installed piping shall be free from sagging. Provide for expansion and contraction of piping in an approved and safe manner by means of loops or offsets, where mechanical expansion joints are not specifically called for.

F. Branch connections from horizontal hydronic system mains shall not be taken off the main bottom, or at less than 45 degrees from horizontal.

G. Branch piping shall be valved at the branch connection points.

H. Provide fittings and specialties necessary to properly interconnect all items, whether or not shown in detail.

I. Piping shall remain protected and capped until just prior to connection. Immediately after assembly, restore all protection and cap unprotected ends to prevent odors, dust, moisture, and other debris from entering the piping system.

J. Clean and swab-out all piping before installation.

K. Lay out pipe lines straight, plumb and in true alignment. Offset as required to avoid interference with other work, to conceal piping, to allow maximum headroom and to avoid interference with windows and doors. Lay out all pipes and establish their levels from bench marks, existing floors or finished grades.

L. Piping shall be concealed unless indicated otherwise on drawings. Do not conceal piping until it has been inspected, tested, flushed and approved.

M. Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of water.

N. Lubricate flange bolts and install with hardened flat washers. Use a torque wrench to tighten flange bolts to the gasket manufacturer’s recommended torque.

O. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves. Install hot and cold water lines at least 6 inches apart.

P. Install piping at least 3 inches clear of electrical conduit. Do not install pipe within the National Electrical Code (NEC) working space zone of electrical equipment. Examples:

1. Above the footprint of electrical equipment in the zone extending 6’ above the installed height of the equipment.
2. Within the NEC working space in front of the electrical equipment. NEC working space varies depending on voltage and other factors, typically for equipment 600 volts or less it extends from the floor to the height of the equipment or 6’-6”, whichever greater, 3’-6” in front of the equipment, and for the width of the equipment or 30”, whichever is greater.

3. Verify NEC clearance requirements prior to installing work. Note that variable frequency drives are considered electrical equipment.

Q. Pipe extending into finished areas shall have chrome plated escutcheons large enough to cover pipe sleeves and shall fit snugly over pipe or insulation.

R. Pitch piping as follows, but not less than required by code:

1. Hydronic piping up in direction of flow at 1/16” per foot
2. Vent piping back toward waste at 1/16” per foot
3. Waste, condensate and compressed air piping down in direction of flow at 1/8” per foot.

S. 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.

1. Support vertical pipe at no less than every floor level, at the base of each riser, and at every riser offset.
2. Support horizontal pipe 5" diameter and greater with a minimum of two pipe hangers between couplings, except sections of pipe less than 4 feet in developed length are permitted to be supported with no less than one hanger between couplings.
3. All horizontal piping 5" diameter and greater shall be restrained or braced to prevent movement at each joint at every direction change and at each branch connection.
4. Provide pipe hangers to support every horizontal branch connection; provide sway bracing when pipe is suspended in excess of 18" by non-rigid hangers, and comply with all other bracing, support, and installation recommendations and suggestions in the CISPI Handbook.
5. Provide hangers and supports to eliminate all misalignment at couplings.
6. Tighten all clamps to coupling manufacturer's recommended torque, using a torque wrench.
7. Joints between dis-similar pipe materials shall be restrained.

3.2 WELDING

A. All welding shall be performed by registered welders qualified to perform welding operations in accordance with the National Certified Pipe Welding Bureau’s procedures and standards, ASME Code Standards and the HPACCNA Standard Manual of Welding.

B. Submit a certified copy of “Record of Pipefitter Welder Performance Qualification Test” of any employees who will be doing welding on this project.

C. No welding to building work shall be allowed without approval of Engineer.

D. Except where prohibited by the Reference Standards, code, or ordinance, Black steel piping larger than 6-inch diameter may be welded with chill rings.

E. Mitered turns will not be allowed. Turns shall be made with factory-made ASME B16.9 long radius wrought steel buttwelding fittings.

F. Except where prohibited by the Reference Standards, code, or ordinance, branch take-offs with manufactured formed nipples will be permitted provided nipple size is at least two pipe sizes smaller than the main size. Formed nipples shall be Bonney Forge “Weldolets”, “Threadolets”, “Sockolets”. In all other cases, use factory-made ASME B16.9 wrought steel buttwelding tee fittings.

G. Shop welded pipe assemblies shall have all welds plainly stamped by the welding operator for inspection by the Engineer before installation.

3.3 INSTALLATION OF PIPE HANGERS AND SUPPORTS

A. Arrange pipe hangers and supports to permit proper pitch of piping, free to move with pipe expansion, installed at proper intervals to totally prevent sagging and attached to building construction through approved means. Hangers shall be located near or at changes in piping direction and concentrated loads. Valves, strainers, in line pumps and other heavy equipment shall be supported independent of the pipes. After systems have been installed and filled adjust hangers and supports to evenly distribute weight, and maintain proper pitch. Refer to drawings for pipe hanger and support details.

B. Vertical Piping: When support locations are not indicated on the drawings, support piping at every floor level.

C. Horizontal Piping Hanger Spacing: Space hangers in compliance with schedule on drawings and applicable codes, or per MSS SP-89, which ever results in shortest spacing.

D. For cold piping, install hangers and supports to maintain an effective continuous thermal and vapor barrier between cold piping and hangers and supports.

E. Plastic Piping: Hang and support in compliance with manufacturer's recommendations. At hangers and supports, including "Unistrut®" style channel supports, install to prevent plastic pipe contact with metal (exception: angle iron may be used for continuous support, provided all sharp edges are removed). Anchor piping only where required for expansion loops or to protect against pressure surges, etc. Compression style clamps/supports shall not be used. Use plastic pipe sleeves or equivalent as guides at all other locations, to allow longitudinal thermal expansion and to prevent lateral pipe movement. Compression style riser clamps shall not be used, use other support methods such a supporting at fitting shoulders. Support valves and other significant weight components independent of pipe. Space hangers no farther than manufacturer's recommendations for the application temperature but in no case farther than recommended for 100 deg. F application temperature. Continuously support all piping 1.5-inch nominal diameter or less (exception: PVC pipe connected to sump pumps). Provide thrust restraints where piping is subject to cyclic pressure surges, e.g. on/off pump applications.

3.4 INSTALLATION OF PIPE SLEEVES

A. Install pipe sleeves where piping passes through building construction including all walls, floors and ceilings.

B. For new wall construction, promptly and accurately locate and securely set sleeves in forms before concrete is poured. For masonry construction, set the sleeves over the piping for Masonry Contractor to build around.

3.5 INSTALLATION OF STRAINERS

A. Provide Y-strainers in water piping preceding control valves, traps, pumps, pressure regulating valves and elsewhere as shown on drawings.

B. Install strainer elements prior to flushing piping. Remove, clean and reinstall during flushing.

3.6 FLUSHING AND CLEANING OF PIPING

A. Flush and clean the following piping systems:

1. Domestic Cold Water (flush only)
2. Domestic Hot Water (flush only)
3. Heating Hot Water Supply and Return (flush and clean)

B. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.

C. Prior to flushing, swab out underground piping to remove all particulate.

D. Prior to flushing, temporarily remove, isolate or bypass dirt sensitive equipment and devices, including the following:

1. Heating coils
2. Boilers
3. Heat exchangers
4. Flow measuring devices

Reinstall after flushing is complete.

E. Prior to flushing, install fine mesh construction strainers at inlet to all equipment. Install fine mesh construction element in permanent strainers. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, clean permanent strainers, remove construction strainers.

F. Flushing for new piping: Flush all piping with cold water for a minimum of one hour, until water runs clear. Water supply shall be equivalent to piping to be flushed. Use (2) 2-1/2" fire hose connections for piping 3" and larger. Drain all low points.

G. Chemical Cleaning for hydronic piping: Where flushing could not be completed at 6 feet per second, circulate flush water and clean strainers prior to installing cleaning chemicals. Provide cleaning chemicals, under the direction of the chemical supplier. Following flushing, install cleaning chemicals and circulate through the entire system for a minimum of one hour, or as directed by chemical supplier. Take water sample for owner's use. Drain system, including all low points. Flush, drain and fill system, circulate for one hour, sample for owner's use. Drain, flush, fill, circulate and sample until system is free of cleaning chemicals, as indicated by analysis of samples.

3.7 PIPING SYSTEMS PRESSURE TESTING

A. General

1. Perform acceptance pressure tests in the presence of the authorities having jurisdiction. Acceptance tests must be satisfactorily completed before piping surfaces are concealed.
2. Pneumatic tests shall be conducted using dry, oil free compressed air, carbon dioxide or nitrogen. Evacuate personnel not directly involved in testing prior to performing pneumatic testing. Perform testing in two stages, initial and acceptance. Conduct initial testing at 5 PSI or less. Swab joints with a commercial leak detector. Repair deficiencies prior to testing at higher pressures. Under no circumstances shall plastic piping of any type be pneumatically tested, including pre-acceptance tests.
3. Components shall be removed or isolated during testing if damage may occur due to test pressure and/or test media.

B. Acceptance Pressure Testing:

1. Perform acceptance pressure testing per the following table.

PIPING SYSTEM PRESSURE TEST TABLE			
SYSTEM	MEDIA	PRESS. (*)	PERMISSIBLE PRESS. DROP
Above Ground Water	Water	200 PSIG	1 PSIG in 2 Hrs.
Waste and Vent	Water	10 Feet	0 Leakage in 10 Minutes

2. Remake leaking gasket joints with new flange bolting. Where welded joints fail, submit proposed method of repair for approval by the Owner's representative and authorities having jurisdiction.
3. For each system tested, provide a certificate testifying that the system was satisfactorily tested and passed, using owner furnished forms.

3.8 FLUSHING, DISINFECTING, AND TESTING DOMESTIC WATER

A. Flush, disinfect and test domestic water piping as follows:

1. Prior to disinfection, flush all domestic water piping as described under Flushing and Cleaning of Piping.
2. Purge and disinfect domestic water piping per plumbing code and City of Frankenmuth requirements. Do not use excessive amounts of disinfectant as it may damage piping seals.
3. Submit water samples in sterile bottles to the City of Frankenmuth. Repeat the procedure if the biological examination made by the City of Frankenmuth shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities. Furnish owner final copy of test results for acceptance.

END OF SECTION 20 1113

DIVISION 21 – FIRE SUPPRESSION

SECTION 21 1313 – WET PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 22 0500 - Common Work Results for Mechanical
2. Section 22 1113 – Piping Materials and Methods

1.2 SCOPE OF WORK

A. Provide piping, fittings, valves and specialties to upgrade the existing automatic wet sprinkler systems as required to serve all Architectural floor plan and ceiling revisions within the boundaries of the Executive Suite Renovation.

B. Provide piping, fittings, valves and specialties for standpipe systems.

C. All wiring related to 21 1313 is covered under Division 26.

1.3 DRAWINGS

A. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the system, shall not be made without the written approval of the architect-engineer, and re-submitted to FM and the authority having jurisdiction for approval.

1.4 QUALITY ASSURANCE

A. Materials, installation and testing shall comply with the following:

1. NFPA 13 - Installation of Sprinkler Systems.
2. FM - Factory Mutual Approval Guide.
3. UL - Fire protection Equipment Directory.
4. FM - Data Sheets.

B. Equipment and Components shall bear UL and FM label or marking and shall be FM approved for fire service.

1.5 SUBMITTALS

A. Submit data, drawings, and hydraulic calculations, as specified in Division 01.

1.6 HYDRAULIC DESIGN CRITERIA

A. Locate mains and risers as indicated. Size piping per drawings, where indicated.

B. Hydraulic calculations shall be per NFPA and FM requirements.

C. Use latest FM water test to ascertain water supply parameters.

D. Sprinkler system zone density requirements shall be based on NFPA for space usage type and building construction (gallons/minute /square foot, gpm/sf).

E. Provide fire protection for soffit areas, void spaces, obstructions, top and bottom of ductwork above 4' wide, closets, and other spaces required by authority having jurisdiction, and at no additional cost to owner.

1.7 EXTRA MATERIALS

A. For projects requiring more than 30 sprinkler heads, provide extra sprinkler heads with metal cabinet and head wrench, per NFPA 13 and FM Data Sheets.

PART 2 - PRODUCTS

2.1 GENERAL

A. All hose threads shall be National Standard.

B. Pressure gauges: Liquid filled 6” dial, 0 to 150 psig range, 5 psig division, with gauge cock.

1. Manufacturers:

a. Trerice Series 600
b. Weiss
c. Marsh

C. All piping materials of a given type shall be manufactured by a single source, and supplied by a single supplier.

2.2 ABOVE GROUND PIPING MATERIAL

A. Wet Pipe Systems: Schedule 40, ASTM A53, black steel pipe with screwed cast iron or malleable iron fittings (or match existing fittings in building) for sizes through 2”, and schedule 10, ASTM A135, black steel pipe with grooved couplings for sizes 2-1/2” and larger.

B. All piping, fittings and accessories shall be rated for a minimum working pressure of 175 psig.

C. Manufacturers:

1. Victaulic Style 005 Rigid Firelock couplings with type "E" EPDM gasket
2. Tyco Grinnell

D. Pipe Hangers: Pipe hangers shall comply with requirements of related sections, be FM approved, and be spaced in accordance with NFPA 13 and FM.

2.3 ABOVEGROUND ISOLATION VALVES

A. General: Provide where shown on drawings, and as required, with valve monitor switch, and means of padlocking open.

B. Isolation valves 2-1/2" and larger: butterfly valve.

1. Manufacturers:

a. Victaulic Series 708
b. Tyco Grinnell

C. Isolation valves 2" and smaller: gate or ball valve, brass body.

1. Manufacturers:

a. Victaulic Series 727
b. Tyco Grinnell

D. Valve monitor switch: Isolation valves shall be supervised open. Provide 115 volt, single pole, double throw roller type monitor switch to signal valve closing.

1. Manufacturers:

a. Tyco Grinnell
b. Anvil
c. Notifier

2.4 SPRINKLER HEADS

A. General: Provide brass sprinkler heads with wide angle spray, thermosensitive glass bulb with temperature rating of 155F to 165F, rated for 175 psig, except as otherwise specified, FM and UL approved. Install sprinkler head type as indicated on drawings. All sprinklers to be quick response.

B. Concealed Pendant Type: Brass finish with cover to match ceiling (black cover color in Board Room, white cover color in all other areas).

1. Manufacturers:

a. Reliable model FIFR
b. Tyco
c. Viking

C. Upright Type: Brass finish.

1. Manufacturers:

a. Reliable model KFR
b. Tyco
c. Viking

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATION REQUIREMENTS

A. Install piping in compliance with Section 221113, Article 3.1, with hanger spacing as dictated by NFPA and FM.

B. Flush per NFPA 13 and FM requirements.

C. Sleeve all piping passing through walls, floors and partitions per details and Section 22 0500.

3.2 VALVE AND SPECIALTY INSTALLATION REQUIREMENTS

A. Inspector's Test Connections: Install where indicated, and if not indicated, at end of most hydraulically remote point for each zone.

B. Drain Valves: Provide downstream of each flow alarm to facilitate testing, at low points trapping more than 5 gallons of water, at base of each riser.

3.3 SPRINKLER HEAD INSTALLATION REQUIREMENTS

A. Locate heads per drawings, FM and NFPA 13, coordinated with lighting, building equipment layout, and other interferences. Aesthetically locate heads with respect to ceiling patterns, tile patterns, masonry bonds and similar constructions lines. Center heads in two directions in ceiling tile, with piping offsets as required.

B. Protect heads, covers and escutcheons prior to painting. Remove protection after painting.

3.4 FIELD QUALITY CONTROL AND TESTING

A. Test equipment per the manufacturer's instructions, NFPA, and FM.

B. Test piping systems per NFPA 13 and the requirements of Factory Mutual.

END OF SECTION 21 1313

SECTION 22 1119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. Provide piping, fittings, and specialties for the following systems:

1. Domestic Cold Water System
2. Domestic Hot Water System (including domestic hot water recirculation system and components)

1.3 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1. National Sanitation Foundation NSF/ANSI-61 (potable drinking water) and NSF-61 Annex G (listed as ≤ 0.25% weighted average lead content) (and/or NSF/ANSI-372) and Annex F.
2. U.S Safe Drinking Water Act.

PART 2 - PRODUCTS

2.1 GENERAL

A. All wetted seals shall be made from materials that are immune from chloramine degradation. EPDM seals shall be peroxide cured.

2.2 PIPING SPECIALTIES

A. Water Hammer Arresters: Certified per PDI Standard WH-201. Bellows type, with stainless steel casing and bellows, pressure rated for 250 psi. Piston type, precharged to 60 psig, suitable for installation in any position.

1. Manufacturers (Bellows):

   a. Zurn Shoktrol
   b. J.R. Smith
   c. Wade

2. Manufacturers (Piston):

   a. Sioux Chief

B. Vacuum Breakers: Hose connection vacuum breakers shall conform to ASSE Standard 1011, with finish to match hose connection.

1. Manufacturers:

a. Chicago
b. Watts
c. Kewannee

C. Backflow Preventer - Reduced Pressure Zone: Includes dual check valves, reduced pressure relief valve and air vent, shutoff valves on inlet and outlet, strainer on inlet, test ports with test cocks, manufacturer's standard materials. ASSE Standard 1013 certified.

1. Manufacturer:

a. Watts 909 Series
b. Conbraco
c. Febco

D. Backflow Preventer - Dual Check Valve: Includes two removable check valve assemblies, manufacturer's standard materials. ASSE Standard 1024 certified.

1. Manufacturer:

a. Watts 7 Series
b. Conbraco
c. Febco

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Install backflow preventers and vacuum breakers where required or shown on drawings, in compliance with the plumbing code and authority having jurisdiction. Install air gap fitting and pipe relief (where applicable) to sanitary waste. Test backflow prevention for proper operation. Tests shall be by Certified Tester. Provide Owner with one (1) copy of each backflow prevention test report.

B. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping serving any plumbing fixtures using automatic valves/electronic solenoid controls.

3.2 FLUSHING, DISINFECTING AND TESTING

A. Flush, disinfect and test domestic water piping as follows:

1. Flush all domestic water piping per Related Section 22 1113.
2. Purge and disinfect domestic water piping per City of Frankenmuth requirements.
3. Submit water samples in sterile bottles to the City of Frankenmuth. Repeat the procedure if the biological examination made by the City of Frankenmuth shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities. Furnish owner final copy of test results for acceptance.

3.3 FLUSHING AND TESTING

A. Flush and test domestic water piping as follows:

1. Flush all domestic water piping per Related Section 22 1113.
2. Submit water samples in sterile bottles to the City of Frankenmuth. Repeat the procedure if the biological examination made by the City of Frankenmuth shows evidence of contamination.

B. Furnish owner final copy of test results for acceptance.

END OF SECTION 22 1119

SECTION 22 1319 – DRAINAGE SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. Provide piping, fittings, and specialties up to point 5 feet beyond the building for the following systems:

1. Sanitary Waste and Vent System
2. Storm Waste System

B. This section specifies materials and installation for the following specialties:

1. Clean-outs
2. Floor Drains

PART 2 - PRODUCTS

2.1 CLEAN-OUTS

A. Floor Clean-Out: Cast iron body, round, adjustable, scoriated, secured, nickel-bronze top, threaded and slotted bronze closure plug, outlet connection to suit application. For carpeted floors, provide nickel bronze carpet clamping frame and cover.

1. Manufacturer:

a. Smith 4020 to 4031
b. Wade
c. Zurn

B. Wall Clean-Out: Treaded bronze plug in cast iron tee or ferrule, with stainless steel cover.

C. Exposed Clean-Out: Threaded plug, of material compatible with system piping.

D. All clean-outs located in patient accessible areas shall have access covers installed with tamper-proof hardware/fasteners.

2.2 FLOOR DRAINS

A. General floor drain requirements: Unless otherwise noted, provide round strainer/ grate, cast iron body, seepage flange and clamping collar, bottom outlet same size as pipe served, with caulked, no-hub or neoprene gasket connection. Load classifications per ASME A112.21.1M. Waterproofing: 40 mils sheet membrane, chlorinated polyethylene, Chloraloy 240.

B. Type FD-1: Light duty, 5” adjustable round top, nickel bronze strainer, minimum strainer diameter equal to twice pipe diameter. For use in staff areas, staff bathrooms/showers and similar locations where noted on drawings.

1. Manufacturer:

a. Smith 2005-A
b. Wade
c. Zurn

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

3.2 INSTALLATION OF PIPING

A. Refer to Related Section 22 1113 for additional requirements.

3.3 INSTALLATION OF CLEANOUTS

A. Provide cleanouts at each change in direction of piping greater than 45 degrees, where indicated on drawings and where required by code. Clean-outs shall be same size as pipe served through 4". Above Ground Cleanouts: Install cleanouts at minimum intervals of 50' for piping 4 inch and smaller and 100' for larger piping, at base of each vertical soil or waste stack.

B. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond and alignment. Coordinate installation with masonry and concrete work.

C. Prior to acceptance of the system, demonstrate that cleanout plugs are easily removable and can be easily rodded.

D. When cleanouts are required in above grade floors, flash and clamp cleanouts in floors provided with membrane waterproofing as specified for floor drains.

3.4 INSTALLATION OF FLOOR DRAINS

A. Install floor drains as indicated on drawings, at low points of surface areas to be drained.

B. Provide trap for all floor drains, minimum 3" trap and waste.

C. Check drainage of surfaces by flooding with the hose.

D. Provide vent for floor drain piping per code, minimum 1 1/2".

END OF SECTION 22 1319

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 22 0500 Common Work Results for Mechanical
2. Section 22 1113 Piping Materials and Methods
3. Section 22 0523 Valves
4. Division 26: Electrical.

C. Alternates: Refer to 01 2300 “Alternates” for the list of alternates and requirements.

1.2 SUMMARY

A. This Section includes the following plumbing fixtures and related components.

1. Water Closets.
2. Water Closet Seats.
3. Lavatories, Sinks, Service Sinks, and related Faucets and Trim.
4. Thermostatic Mixing Valves (for hand-wash facilities).
5. Shower Control Valves.
6. Accessories: Supply Tubes and Stops.
7. Installation of fixtures including fixtures supplied by others for casework.

B. Related Sections include the following:

1. Section 01 9100 "Full Project Commissioning" for commissioning requirements.

1.3 SUBMITTALS

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

1. Construction details, material descriptions, rated capacities, operating characteristics dimensions of individual components and profiles, and finishes for fixtures.
2. Water consumption data.
3. Wiring diagrams for power, signal, and control wiring
4. Proof of compliance to NSF/ANSI 61.

1.4 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.5 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. The Contractor shall verify and resolve compatibility between separate components (e.g. that lavatory hole quantity and centering match that of the specified faucet, supports are compatible with respective urinals and water closets, etc.). **Model numbers, when provided, are partial model numbers for identifying style. Provide fixtures that meet all the specified requirements.**

C. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

1. Michigan Plumbing Code
2. National Sanitation Foundation NSF/ANSI-61 (potable drinking water) and NSF-61 Annex G (listed as ≤ 0.25% weighted average lead content) (and/or NSF/ANSI-372) and Annex F.
3. U.S Safe Drinking Water Act.

1.6 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

1.7 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with original design and referenced standards.

1.8 DELIVERY, STORAGE AND HANDLING

A. Package for delivery to best protect finish surfaces while using the least amount of single-use packaging as possible. If possible, package and ship product using reusable blankets and fabrics or reusable cardboard and crate systems.

B. When storing prior to installation, raise off floor on pallets, stack flat with protective material between to eliminate chance of creating nicks, scratches, and other imperfections and damage to finish surfaces, wrap weather-tight, and provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

2.2 WATER CLOSETS – GENERAL

A. Vitreous china; color white unless noted otherwise. Elongated bowl, close coupled, two-piece, floor mount bottom outlet, completely skirted. For 12 in. rough-in (floor mounted models). Dimensions within ASME Standard A112.19.2 tolerances.

B. Shall meet ASME A112.19./CSA B45.1, ASME A112.19.142 flush requirements at 0.8 gpf (liquids disposal) and 1.28 gpf (solids disposal) when equipped with a dual flush style valve.

2.3 WATER CLOSETS (EXECUTIVE SUITE TOILET ROOMS AND SHOWER)

A. Water Closets, WC-1: Vitreous china, two-piece tank type, floor mounted, bottom outlet, completely skirted with low friction ceramic glaze. Water closet shall be ultra high-efficiency dual flush rated at 0.8 and 1.28 gpf. ADA compliant.

1. Manufacturers:

   a. TOTO - Aquia CST446CEMFG

2. Style: Close coupled, two-piece tank type.
3. Bowl Type: Elongated bowl, floor mounted, bottom outlet with completely skirted base. 12” rough-in.
4. Height: ADA compliant.
5. Design Consumption: High-efficiency, dual-flush, 0.8 and 1.28 gpf.
6. Color: White.
7. Supply: NPS 3/8” chrome-plated brass or copper with loose-key stop.
8. Flushometer: Manual chrome push-button dual flush located on top center of tank assembly.
9. Fixture Support: Floor mounted support with skirted base and internal floor mounting bolts.
10. Toilet Seat: Elongated soft-close toilet seat by water closet manufacturer (TOTO).

2.4 WATER CLOSET ACCESSORIES

A. Toilet Seat, WCS-1: 1" high, solid plastic, with extended back and brass bolts.

1. Manufacturers:

   a. TOTO

2. Configuration: Open front with soft-close seat and cover.
3. Size: Elongated.
4. Molded-in bumpers
5. Class: Heavy-duty commercial.
6. Hinge Type: CC/SS, self-sustaining, check.
7. Color: White.

2.5 LAVATORIES (EXECUTIVE SUITE TOILET ROOMS AND SHOWER)

A. Lavatories, LAV-1: Lavatory integral with solid surface vanity top. Provided by Architectural trades. Vanity top.lavatory installed by Architectural/General trades and specified in another section. Fixture/installation shall be ADA compliant.

B. Installed by architectural (general) trades and specified in another Section. Lavatory Faucet LF-1.

1. Manufacturers: By Architectural/General trades. Refer to Specification Section 06 4023.
2. Type: With back.
3. Size: Custom. Refer to Architectural.
4. Faucet Hole Punching: Single center hole. Coordinate with faucet manufacturer.
5. Faucet Hole Location: Top.
6. Color: To be determined.
7. Faucet**:** LF-1.
8. Supplies: NPS 3/8 chrome-plated copper with stops.
9. Drain: Fixed grid strainer.
10. Drain Piping: Offset NPS 1-1/4 by NPS 1-1/2 chrome-plated cast-brass trap; 0.032-inch-thick tubular brass waste to wall; and wall escutcheon.
11. Fixture Support: Solid surface counter top with integral lavatory bowl cabinet mounted.
12. Mixing Valve: Water mixing valve ASSE 1070.

C. LAV-2: Lavatory integral with solid surface vanity top. Provided by Architectural trades. Vanity top/lavatory installed by architectural (general) trades and specified in another Section. Fixture/installation shall be ADA compliant.

1. Manufacturers: By Architectural/General trades. Refer to Specification Section 06 4023.
2. Type: With back.
3. Size: Custom. Refer to Architectural.
4. Faucet Hole Punching: Single center hole. Coordinate with faucet manufacturer.
5. Faucet Hole Location: Top.
6. Color: To be determined.
7. Faucet**:** LF-1.
8. Supplies: NPS 3/8 chrome-plated copper with stops.
9. Drain: Fixed grid strainer.
10. Drain Piping: Offset NPS 1-1/4 by NPS 1-1/2 chrome-plated cast-brass trap; 0.032-inch-thick tubular brass waste to wall; and wall escutcheon.
11. Fixture Support: Solid surface counter top with integral lavatory bowl cabinet mounted.
12. Mixing Valve: Water mixing valve ASSE 1070.

2.6 LAVATORY FAUCETS

A. Lavatory Faucet, LF-1: Electronic, infrared sensor-activated, hand washing faucet with adjustable hot/cold water temperature control. ADA compliant.

1. Faucet, supplies, and stops shall be NSF/ANSI-61-G listed as ≤ 0.25% weighted average lead content.
2. All welded components to be stainless steel and copper. Exterior finish to be polished chrome.
3. All faucet components serviceable from above deck.
4. Electronic valve with touchless sensor activated control hard wired low voltage with plug transformer power supply.
5. Single center hole mounting with 4” trim plate. Coordinate with lavatory manufacturer.
6. 0.50 gpm vandal resistant spray head.
7. Adjustable time-out control (factory default 10 seconds).
8. Hot and cold water mixed temperature end-user adjustable control.
9. Trim: Check stops, fixed grid strainer, tailpiece, P-trap with clean-out, waste to wall, escutcheons; all chrome plated brass.
10. ASSE 1070 mixing valve.
11. Acceptable manufacturers and models:

    a. Sloan, model EFX-200-4-HLP-BDT-CP-0.5 GPM

2.7 SINKS

A. Sink, SK-1: Kitchen sink, under-mount, single bowl with racks, AISI Type 304 stainless steel, 16 gage. Coat underside with sound deadening non-marring mastic. ADA compliant.

1. Manufacturers:

    a. Kohler “Strive” K-5409

2. Type: Under counter mounted.
3. Rectangular Size: 29” x 18-5/16” wide overall; 27-1/4” x 16-9/16” x 9” deep inside bowl.
4. Faucet: SF-1.
5. Rear drain position.
6. Supplies: NPS 3/8 chrome-plated steel reinforced flexible tubing. Brasscraft or C, S & B
7. Stops: Keyed ball valve stops.
8. Drain: Disposal flange with stopper, 4-1/2” diameter (K-11352).
9. Drain Piping: Offset NPS 1-1/2 chrome-plated cast-brass trap; 20ga- cast brass waste to wall; and wall escutcheon.

10. Mixing Valve: Refer to SF-1 for tempering device requirements.
11. ADA
12. Food Waste Garbage Disposal: GD-1 with wall switch.

2.8 SINK FAUCETS

A. Sink Faucet SF-1: Kitchen style, touchless AC-powered on/off control with single-lever hot/cold and flow rate manual adjustment. Gooseneck spout with three-function pull-down spray head. ADA compliant.

1. Manufacturers:

   a. Kohler “Riff” K-23832

2. Maximum Flow Rate: 1.5 GPM laminar faucet, constant flow pressure compensating.
3. Body Material: Low-Lead cast brass.
4. Finish: “Vibrant Stainless” color/finish.
5. Type: Single control Kitchen Faucet with touchless AC-powered on/off control.
6. Centers: Faucet and gooseneck single mounting hole.
7. Mounting: Deck, concealed
8. Handle: Single-Lever metal hot/cold and flow rate manual adjustment.
9. Inlet(s): NPS 3/8 tubing, with compression fittings.
10. Spout: 16-3/4" Gooseneck, 9" reach, 9" discharge above sink. Rigid spout with pull-down spray head.
11. Spout Outlet: Magnetic docking pull-down spray head outlet with three-function touch control spray pattern.
12. Flow Control: Ceramic Disc Valve Cartridge.
13. Tempering Device: ASSE 1070

2.9 GARBAGE DISPOSAL

A. Garbage Disposal, GD-1: Sink-mounted, food waste disposal . Include 115 VAC, 1,725 rpm, 3/4 HP motor with overload protection. reset button, electrical power cord with plug to switched wall outlet; corrosion-resistant chamber with jam-resistant stainless steel grind components and shear ring. NPS 1-1/2" outlet; quick-mounting, stainless steel anti-vibration sink flange; anti-splash guard; combination cover/stopper. Garbage disposal shall be designed for low noise operation and include low-vibration sound reducing sink baffle connection collar. Disposal shall comply with ASSE 1008 and UL 430.

1. Manufacturers: Emerson In-Sink-Erator; Food Waste Disposer - "Evolution Compact"

2.10 DISHWASHER AIR-GAP FITTINGS

A. Description: ASSE 1021, fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of a least 5 gpm; and inlet pressure of at least 5 psig at temperature of at least 140 deg F. Include 5/8" ID inlet and 7/8" ID outlet hose connections.

B. Hoses: Rubber suitable for temperature of at least 140 deg F.

1. Inlet Hose: 5/8" ID and 60" long.
2. Outlet Hose: 7/8" ID and 60" long.

2.11 THERMOSTATIC MIXING VALVE - HAND WASHING AND SINK FACILITIES

A. Michigan Plumbing Code:

1. An ASSE 1070 mixing valve (water temperature limiting device) shall be installed in hot water supply piping. The ASSE 1070 mixing valve shall be certified for a minimum flow rate of 0.5 gpm or less.

B. Provide a thermostatic mixing valve at all sinks and public lavatories including at accessible plumbing fixtures.

C. Provide mixing valves based on the following selection criteria:

1. Mixing valve serving a single fixture: Valve pressure drop shall not exceed 5 psi at 1 gpm flow rate.
2. Mixing valves serving sink faucets (all types, including service sinks), valve pressure drop shall not exceed 5 psi at 4 gpm flow rate.

D. Mixing valve specification:

1. Manually adjustable thermostatically controlled domestic water tempering valve.
2. ASSE 1070 listed to control down to 0.5 GPM flow rate.
3. All bronze or brass body, rough finish, chrome plated if exposed. Brass and stainless steel internal components.
4. Chloramine resistant seals.
5. Integral check valves and stainless steel strainers (screens) in hot and cold water inlet connections.
6. Tamper resistant temperature adjustment handle.
7. Union with male or female NPT connections, or compression fittings.
8. Valves shall operate properly:

   a. At supply pressures between 20 PSIG and 125 PSIG.
   b. With up to 20 percent pressure differential between hot and cold water supplies.

9. Outlet temperature shall be adjustable to within 10 deg. F of inlet hot water temperature.
10. Hot Inlet Maximum Temperature: 180 deg. F.
11. Lower Temperature Adjustment Range: not less than 85 deg. F.
12. Upper Temperature Adjustment Range: not more than 115 deg. F.
13. Provide a second set of check valves on the hot and cold water inlet connections in addition to the integral check valves.

E. Acceptable manufacturers and models:

1. Powers Hydroguard, Series LFLM495
2. Symmons Maxline
3. Wilkins Aqua-Gard
4. Acorn Controls, model no. ST70
5. Cash Acme

2.12 SHOWER PLUMBING FIXTURES AND COMPONENTS

A. Shower Faucet/Head, SH-1: Single handle, hot/cold and volume control with integral push-button diverter valve for handheld shower. Pressure and temperature-balancing mixing valve with screwdriver service stops and adjustable stop screw. All brass with polished chrome finish. Shower valves shall conform to ASSE 1016 and be ADA compliant.

1. Manufacturers:

   a. Kohler “Purist” K-11748-KS

2. Maximum Flow Rate @ 60 psi: 2.5 gpm, unless otherwise indicated.
3. Body Material: Cast brass.
4. Finish: Polished chrome plate.
5. Type: Thermostatic and pressure balance.
6. Mounting: Flush.
7. Anti-scald Device: Integral with mixing valve, set not to exceed 110 °F.
8. Supply Connections: NPS 1/2.

9. Shower Head No. 1: Kohler - "Alteo" K-45123

   a. Wall-mount Shower Arm & Flange : Kohler "Purist" K-933

10. Shower Head No. 2: Kohler - "Purist" K-22178

   a. Hand-Held Shower Kit with Multifunction Spray Head
   b. 60" Metal hose with Kohler - "Exhale" K98352 wall suppl elbow
   c. 30" Slide-bar with adjustable mounting brackets.

11. ANSI: A117 certified.

2.13 FLOOR/SHOWER DRAINS

A. General Floor Drain Requirements: Unless otherwise noted, provide round strainer/grate, cast iron body, seepage flange and clamping collar, bottom outlet same size as pipe served, with caulked, no-hub or neoprene gasket connection. Load classifications per ASME A112.21.1M. Waterproofing: 40 mils sheet membrane, chlorinated polyethylene, Chloraloy 240.

B. Type FD-1: Light duty, 5” adjustable round top, nickel bronze strainer, minimum strainer diameter equal to twice pipe diameter. For use in staff areas, staff bathrooms/showers and similar locations where noted on drawings.

   1. Manufacturer:

      a. Smith 2005-A
      b. Wade
      c. Zurn

C. Floor Drains FD-1: Install floor drain FD-1 in bathroom shower.

2.14 ACCESSORIES

A. Supply Tubes, Stop Valves, and Escutcheons for Faucets: Sweat, threaded or compression connection. Rigid supplies. Valves and escutcheons chrome plated brass where exposed, may be rough brass where concealed. Supply tubes chrome plated brass. Brass tubes NSF/ANSI-61-G listed as ≤ 0.25% weighted average lead content.

B. Stop valves shall be quarter turn type with chrome plated body and metal handle, brass alloy body, stem and ball, PTFE seats, viton and nitrile stem seal, NSF/ANSI 61 and NSF/ANSI 372 compliant.

   1. Manufacturer:

      a. Watts
      b. Chicago Faucets
      c. BrassCraft KT Series
      d. Faucet manufacturer
      e. McGuire

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 fixture installation. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation. Confirm that millwork/casework is constructed with adequate provision for the installation of countertop lavatories and sinks.

C. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations

D. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions. Install mounting bolts in every fixture/fixture carrier mounting bolt hole, and bolt to the building substrate.

B. Install counter-mounting fixtures in and attached to casework.

C. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

D. 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 or globe valve if stops are not specified with fixture. Refer to Section 220523 "Valves" for general-duty valves.

E. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

F. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

G. 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.

H. Install all pipe, traps, fixtures, stops, valves, drains and plumbing accessories to maintain ADA/barrier free clearances.

I. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

J. Install fixture traps to maximize clearance below trap.

K. Install check valves in the hot and cold water supply connection immediately upstream of each mixing valve, in the hot and cold water supply to the mixing valve, even when equipped with integral checks.

L. Install control transformers and wiring for sensor operated devices.

M. 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. Refer to Section 22 0500 "Common Work Results for Mechanical" for escutcheons.

N. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Section 07 9200 "Joint Sealers" for sealant and installation requirements.

3.3 INSTALLATION OF WATER CLOSETS – STANDARD AND BARRIER FREE

A. Mounting Heights:

1. Water Closets – Standard: 15" to 17" from top of toilet seat to finished floor.
2. Water Closets – Barrier Free: 17" from top of toilet seat to finished floor.

B. Flush Valve: Mount flush valve handle on wide side of stall/room.

C. Install toilet seats on water closets.

3.4 INSTALLATION OF LAVATORIES/SINKS – STANDARD AND BARRIER FREE

A. General: Unless otherwise noted on drawings, locate lavatory in compliance with ADA requirements.

B. Countertop: Coordinate with architectural trades.

C. Install a water tempering valve for each lavatory, kitchen hand sink and sink faucet.

3.5 THERMOSTATIC MIXING VALVES AND PRESSURE-BALANCING AND TEMPERATURE MIXING VALVES FOR ALL SINKS, LAVATORIES AND SHOWERS

A. Install in location readily accessible for cleaning, adjustment and valve/cartridge replacement.

B. Install mixing valve after checks and stops are installed. Thoroughly flush all piping immediately prior to mixing valve installation.

C. Thoroughly flush all piping prior to installation.

D. Install isolation valves on hot water and cold water inlet connections near mixing valve.

E. Install check valves between the mixing and mixing valve isolation valves. Check valves are in addition to the mixing valve integral check valves.

F. Install a downstream thermometer with a range of 0-140 deg. F, to measure the mixed temperature. Not required if tempering valve is supplied with an integral thermometer.

G. Adjust valve temperature set point to 110 °F to 115 °F, or as indicated on drawings. Follow manufacturer's adjustment instructions.

3.6 INSTALLATION OF PLUMBING FIXTURES

A. Individual water line branches, waste lines, vents and traps for connection to individual fixtures, fixture fittings and specialties shall be per the following schedule or as indicated on drawings, whichever is greater (sizes are given in inches).

Item	Waste	Vent	Trap	Cold	Hot
Water Closet	4	2	--	1-1/4	--
Lavatory	1-1/2	1-1/2	1-1/4	1/2	1/2
Sink	1-1/2	1-1/2	1-1/2	1/2	1/2
Shower	2	2	--	1/2	1/2

3.7 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

F. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.8 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed 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.

3.9 COMMISSIONING

A. Perform the commissioning activities as outlined in the Division 01 Section for Commissioning and other requirements of the Contract Documents.

3.10 ADJUSTING AND CLEANING

A. Flush all water closets and verify performance. Adjust or clean flush valves to produce proper flow.

B. Back-flush shower heads, faucet aerators/spray heads, and in-line strainers wherever installed, and reinstall.

C. Adjust shower control valve limit stops to deliver maximum 120 deg. water.

D. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise or overflow.

E. In sensor operated flush valves and faucets. Adjust sensor operation to satisfaction of commissioner.

F. At completion of project, remove excess caulk and sealants and clean plumbing fixtures and equipment.

3.11 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4200

SECTION 23 0593 – TESTING, ADJUSTING AND BALANCING (TAB)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. Adjust and balance the following systems:

1. Supply air systems
2. Return air systems
3. Exhaust air systems
4. Hydronic systems
5. Domestic hot water systems

B. Conduct the following systems testing:

1. Vibration testing

C. Hydronic Balancing shall include as a minimum all devices for which a GPM is indicated in the plans, schedules or specifications.

D. Air Balancing shall include as a minimum all devices for which a CFM is indicated in the plans, schedules or specifications.

E. Testing, Adjusting and Balancing Reports, as detailed in part 3.

1.3 QUALITY ASSURANCE

A. The Contractor shall obtain the services of an independent (third party) Test, Adjust and Balance (TAB) Contractor.

B. Air balance and water balance shall be done by the same Test and Balance Contractor.

C. Testing and balancing shall be performed in accordance with standards of either AABC ("National Standards for Field Measurement and Instrumentation - Total System Balance", Current Volume and Supplements,) or NEBB ("Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems"), and ASHRAE Standard 111-1988.

D. The TAB supervisor shall be currently certified under the requirements of either NEBB or AABC, and shall directly supervise the project TAB activities. Supervisors shall be certified in all areas germane to the project's work scope: air, hydronic, fume hood and sound/vibration testing. Sound and vibration testing may be subcontracted to other qualified firms as approved by the Engineer.

E. Test equipment accuracies shall be no less than recommended by NEBB or AABC; provide higher accuracy test equipment if dictated by project needs. Test equipment shall have been calibrated within the time intervals recommended by NEBB or AABC, but in all cases shall have been calibrated within the last year.

1.4 ACCEPTABLE BALANCING CONTRACTORS

A. The following are the only acceptable balancing companies:

1. Hi-Tech Test & Balance (989) 695-5498, 10765 Geddes Road, Freeland, MI 48623

1.5 SUBMITTALS

A. Provide the following for approval:

1. Test instrument list including the following information:

   a. Instrument type and accuracy
   b. Instrument manufacturer and model number
   c. Instrument serial number
   d. Copy of current calibration certificate

2. Proof of TAB supervisor certification.
3. Resume of the TAB supervisor and of all TAB technicians proposed for the project.
4. Proposed reporting forms for each TAB procedure.

1.6 SEQUENCING AND SCHEDULING

A. Where performance testing is specified, equipment and systems must be tested under conditions that are near design conditions. Various components and systems shall be tested in summer or winter design conditions to accurately reflect specified conditions.

1.7 WARRANTY

A. For a period of 90 days after the acceptance of the balancing report, the TAB contractor shall recheck or reset any part of any system to meet the Owner's needs, where these variations are within the capabilities of the equipment.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION:

3.1 PREPARATION

A. Pre-Balancing Conference: Prior to the pre-balance conference, inspect system readiness for testing, adjusting, and balancing (TAB). Prepare and submit a list of system deficiencies. Afterwards, meet with the Project Engineer, Commissioner and contractors to resolve system deficiencies, to verify TAB procedures and system readiness for TAB, and to coordinate TAB activities and schedule.

B. Test and Balance General Project Overview:

1. Prior to demolition, record measurements of existing Central HVAC unit/system air and hydronic flow rates serving the executive suite spaces and associated near-by areas that could be impacted by HVAC construction work in the Executive Suite areas.
2. During HVAC renovation work in the Executive suite areas, temporarily adjust the corresponding central system AHU airflow settings as needed to maintain comfort levels in the surrounding areas that will continue to be occupied and operational during construction.
3. Upon completion of Executive Suite renovation, Re-balance central AHU airflow settings to previously measured quantities including any revisions resulting from the Upgrade project. Re-balance adjacent areas to original air and hydronic flow rates recorded prior to construction

C. Scheduling: Identify to the contractor anticipated durations for TAB work, and what items must be complete prior to proceeding with TAB work. Allow sufficient time in the construction schedule for TAB prior to final project inspection.

D. Conduct final TAB after system has been completed and is in full working order. Prior to completing balancing, inspect and test systems and components to verify proper installation and operation, including but not be limited to:

1. Verify strainers and filters are installed and clean.
2. Verify motor and equipment rotation, lubrication and alignment.
3. Align belts and pulleys. Adjust tension.
4. Check operation of all automatic valves and dampers.
5. Check position of isolation valves and dampers.
6. Verify air has been vented from hydronic systems.

E. In cooperation with other contractors, correct deficiencies.

3.2 TESTING, ADJUSTING AND BALANCING - GENERAL REQUIREMENTS

A. Notify Commissioner when testing and balancing activities are commencing.

B. Immediately notify the Commissioner and owners representative when any deficiencies are detected, whether associated with design, installation, or equipment.

C. Properly repair any damage to mechanical systems resulting from TAB procedures, e.g. patch duct test holes, repair pipe insulation, etc.

D. TAB contractor shall provide all required tools and equipment necessary to perform TAB services. Take measurements with certified and calibrated devices. Do not use field installed sensors and gauges.

1. Exception: Magnetic flow meters may be utilized for flow measurements when available. However, the TAB contractor shall make secondary checks such as pump pressure readings and shall indicate the results of those tests in the TAB report.

E. Take air and hydronic measurements on equipment at the same time, e.g. take air handler coil water flow data at the same time as air handler air side data.

F. Measure the total air and water flow rate of each system and each major system component.

G. Coordinate work with the building controls contractor(s).

H. Measure motor and equipment speed (RPM) with strobe tachometer. Record full load and part load slippage, and calculate motor brake horsepower (BHP) using BHP= nameplate HP x (part load slip / full load slip).

3.3 AIR BALANCING - GENERAL REQUIREMENTS

A. Place systems in operation with filters installed and control systems complete and operating. Temporarily block filters to simulate dirty filter pressure drop (obtain dirty filter pressure drop from drawing schedules. If not stated, contact design engineer to obtain). Balance systems to design ratings. Adjust each air terminal unit, inlet and outlet within plus or minus 10 percent of design requirements, but total air for each system shall be not less than shown.

B. Check flow rates for all factory set air terminal units and reset if not correct.

C. Adjust fan speeds by adjusting or replacing sheaves and belts. If replacement is required, follow project change order procedures and obtain authorization prior to proceeding.

D. Set supply fan static pressure as low as practicable while maintaining required pressure at the most aerodynamically remote terminal units.

E. Record pressure drop readings across all major system components and significant drops within duct systems.

F. Verify the calibration of air flow measuring stations by taking traverse readings across associated ducts.

G. For belt drive fans equipped with variable speed drives, set the drive to 60 hertz and measure motor and fan RPM to validate that, at the maximum drive speed setting, the fan rotates at the maximum design fan speed. The maximum design fan speed shall be as indicated on the approved fan curve. Assure that running the fan at maximum design speed will not cause any damage prior to making this test. Direct drive fans with design fan speeds greater than 1800 rpm will require motor operation above 60 hertz.

3.4 AIR BALANCING - VARIABLE VOLUME SYSTEMS (INCLUDING CAV AND VAV BOXES)

A. Balance systems to minimize throttling loses and to optimize (reduce to lowest possible) end-of-line (E-O-L) differential pressure set points. Prior to beginning balancing, meet with the project Commissioner and agree to the exact procedures to be followed. Set static pressure set points to ensure the most hydraulically remote terminal unit can achieve design flow. Measure flow at each terminal unit individually to verify scheduled design flow is achieved at the lowest possible differential pressure set point. Reset E-O-L set point and re-measure flow at each terminal unit until the lowest E-O-L set point is achieved. For DDC systems, coordinate with DDC programmer to optimize E-O-L set point where the sum of the loads exceeds system capacity, the ratio of capacity/loads is defined as the system diversity factor. Calculate diversity factor and indicate calculated diversity factor in the balance report. Adjust belts and sheaves to achieve design flow. Test maximum equipment capacity with all boxes forced open to design maximum CFM. Document design diversity, actual diversity, E-O-L set point, and fan volume. Show all calculations

B. Verify each VAV box for proper control: normally open or normally closed position, and type of control.

C. Check each individual VAV box for minimum and maximum flow. Calibrate boxes as required to meet design CFMs. For electronically controlled boxes, check and correct correction factor at each box. Coordinate with the DDC programmer.

D. Check supply and return fan tracking and assure compliance with design requirements.

3.5 AIR BALANCING - AIR HANDLING EQUIPMENT AND SYSTEMS

A. Test air handling units, exhaust and return fans, and associated automatic dampers in all modes of operation. Determine the most restrictive operating mode and balance systems in this mode.

B. In addition to values listed in ASHRAE Standard 111-1988, the following shall also be measured and reported:

1. Minimum and maximum outdoor air quantities. (Include setting minimum outside air where applicable.)
2. Power factor or watts for motors larger than 10 HP
3. Component air pressure drops, including across open dampers.

C. Record actual motor amps, volts, and rpm, and fan flow, static pressure and rpm.

D. Check all equipment motors, belts, drives, bearings, filters.

E. Check supply and return fan tracking/offset by traverse duct measurements and validate compliance with design requirements.

F. For new air handling units, fan coils, or any other air handling equipment equipped with a condensate drain: In conjunction with the commissioner, test cooling coil condensate drain and trap performance. Artificially load filters to simulate dirty filter conditions. Verify drain pan does not overflow, and air does not blow by trap.

3.6 HYDRONIC BALANCE - GENERAL REQUIREMENTS

A. Perform final hydronic balance after all systems have been flushed, cleaned, and filled.

B. Test hydronic systems in all modes of operation. In general, balance systems in the most restrictive operating mode.

C. Hydronic balance includes performance readings (flow, pressures, temperatures) on all pumps, coils, heat exchangers, and flow measuring devices. For coils 3 gpm or less at terminal units, record flows only. Adjust pump flows to actual system heads by adjusting balancing valves (constant volume systems). Flow measuring devices take precedence over pump head readings. Record discrepancies for evaluation. Provide pump head and flow (i.e. flow determined from shut off head, operating head and pump curve) and flow measuring device data.

D. Report pressure drop readings across all major system components both for flow determination and for deviations between actual and design values.

E. Record the pressure drop across water filtering devices.

F. Where Y or basket strainers are equipped with inlet and outlet pressure gauges, record the pressure drop.

G. Record (on flow diagrams) the flows and pressures obtained in each of the various circuits and modes of operation. Measure flows in parallel pumping systems when operating independently and jointly.

H. Adjust and set the memory stop for each balancing valve.

I. For auto-balancing valves, record differential pressure with auto-balancing valve throttling against maximum flow mode. .

J. For 3-way control valves, balance “bypass” flow to match “through” flow unless drawings indicate a different bypass flow.

K. In general, balance variable flow systems to achieve design flow at all units simultaneously. Where the sum of the loads exceeds system capacity, the ratio of capacity/loads is defined as the system diversity factor. Calculate diversity factor and indicate calculated diversity factor in the balance report. Balance variable flow systems to minimize throttling loses and to optimize (reduce to lowest possible) differential pressure set points. Prior to beginning balancing, meet with the project Commissioner and agree to the exact procedures to be followed. Set static pressure set points to ensure the most hydraulically remote load can achieve design flow. Measure flow at each load individually to verify scheduled design flow is achieved at the lowest possible differential pressure set point. Reset and re-measure flow at each load until the lowest differential pressure set point is achieved. Verify that no control valve “lifts” at the final differential pressure set point, by closing all other control valves, allowing the controls to settle to the differential pressure set point, and then verifying the valve remains fully closed. Record the final differential pressure set point in the TAB report. Throttle balance valves at loads only as required to obtain accurate flow data; generally balance valves should otherwise be left fully open. (Exception: throttle balance valves at stacked coil sections (or similar arrangements) to provide equal flow to each coil in the stack.) For DDC systems, coordinate with DDC programmer to optimize differential set point.

3.7 VIBRATION TESTING

A. Perform vibration measurements for all rotating equipment 1/2 horsepower and larger, including compressors, pumps, fans and motors.

B. Inspect vibration isolation system and alignment and report deficiencies.

C. Allowable Vibration Tolerances: Self-excited, vibration maximum velocity shall not exceed the following limits, measured in inches per second RMS (not in mils peak to peak), filter in. Measure vibration at bearing caps of machine in vertical, horizontal and axial directions or at equipment mounting feet if bearings are concealed.

1. Except where noted otherwise: 0.20
2. Pumps: 0.13
3. Fans: 0.09

D. For variable speed equipment, inspect at full range of speeds. Verify the maximum safe speed the system can be run at before beginning tests. Modulate speed from minimum to maximum to test for possible harmonic vibrations. Record vibration at maximum operating speed and at any speed displaying harmonic vibration.

E. Include in the report a summary sheet indicating pass / fail for each unit. For each unit of equipment, record detailed initial measurements, corrections made, retest measurements, and suggested course of action for equipment that still fails limits after contractor correction.

3.8 COMPLETION SERVICES

A. Final Check: Make final checks and complete any testing as directed.

B. Acceptance: Final acceptance of the project will not be made until a satisfactory report is received. Owner reserves the right to spot check the report by field verification prior to final acceptance.

3.9 TESTING, ADJUSTING, AND BALANCING REPORT

A. Submit TAB reports in compliance with specifications and the requirements listed below.

B. Submit progress TAB reports within 3 days of balancing *each* air, hydronic, and plumbing system, and more frequently if requested by the project Commissioner. Submit the final TAB report within one week of completing all testing, adjusting and balancing

C. Report all data in inch/pound units.

D. Provide date and time all readings were taken.

E. Include brief system descriptions, deficiencies, corrections made, unresolved problems, and recommendations.

F. Provide as-built schematic sketches for each system indicating all equipment, balancing related components, terminal devices, diffusers, grilles, registers, and valves. Use equipment nomenclature as defined in construction documents. Indicate room numbers, and correlate all devices to the balance report data.

G. Include a list of all testing equipment and devices used, including type, accuracy, manufacturer, model number, serial number, and calibration date.

H. Include definition of all abbreviations and acronyms, and all formulas used in calculations.

I. Provide the outside air dry bulb and wet bulb temperature at the beginning and end of each TAB day, correlated to the day's TAB work.

J. Number all report pages. Tab major sections of the report and provide a report table of contents.

K. Include complete nameplate data for all equipment.

L. Include flows and pressures in all operating modes. Indicate final E-O-L differential pressure set points, and the results of all tests.

M. Describe TAB procedures used; including procedure used in establishing differential pressure set point for variable speed drive controlled systems.

END OF SECTION 23 0593

SECTION 23 0900 – INSTRUMENTATION AND CONTROL FOR HVAC

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.

B. Related Sections

1. Division 20: Mechanical Systems Requirements
2. Division 22: Plumbing
3. Division 23: Heating, Ventilating and Air-Conditioning (HVAC)
4. Division 26: Electrical
5. Division 28: Electronic Safety and Security

1.2 SUMMARY

A. This Section Includes:

1. Building Automation System (BAS), including controls for mechanical equipment to control temperature, humidity, ventilation, pressure, and other functions as indicated.
2. BAS Operator Interface system including operator interface for monitoring and control of connected systems and equipment.
3. Refer to Drawings for Sequence of Operations and additional requirements related to this section.

B. Scope of Work:

1. The Mechanical Systems Controls Contractor (MSCC) shall provide and install all controls, sensors, wiring, control valves, dampers, electrical, and accessories as indicated and as necessary for a complete mechanical controls solution.
2. The MSCC shall complete systems integration into the existing Owner common BAS Operator Interface System (OIS) for the remote monitoring and control of the BAS including but not limited to BAS system point monitoring, developed system graphics, point trends, equipment schedules, and system alarm annunciation.
3. The MSCC shall complete field installation of devices, wiring, and integration into the central Operator Interface system as indicated in project Drawings and Specifications for Units provided with packaged controls by the unit manufacturer.
4. The MSCC shall complete integration of any auxiliary systems (ie. Laboratory Controls, Lighting Controls, Power Monitoring, Fire Alarm system, Security Systems, etc.) into the central Operator Interface system as indicated in the project Drawings and Specifications. MSCC shall review project Drawings and Specifications as necessary for any requirements and details regarding auxiliary systems integration.

1.3 DEFINITIONS

A. AE: Architect/Engineer

B. BACnet: Communications Protocol for Building Automation and Control Networks

C. BAS: Building Automation System

D. BMS: Building Management System

E. BTL: BACnet Testing Laboratories

F. B-AWS: BACnet Advanced Operator Workstation

G. B-OWS: BACnet Operator Workstation

H. B-OD: BACnet Operator Display

I. B-BC: BACnet Building Controller

J. B-AAC: BACnet Advanced Application Controller

K. B-ASC: BACnet Application Specific Controller

L. B-LD: BACnet Lighting Device

M. B-SS: BACnet Smart Sensor

N. B-SA: BACnet Smart Actuator

O. B-RTR: BACnet Router

P. B-GW: BACnet Gateway

Q. B-BBMD: BACnet Broadcast Management Device

R. B-GEN: BACnet General

S. DDC: Direct Digital Control

T. EPROM: Erasable Programmable Read-Only Memory

U. EEPROM: Electronically Erasable Programmable Read-Only Memory

V. IP: Internet Protocol

W. IT: Information Technology

X. LAN: Local Area Network

Y. LCC: Laboratory Controls Contractor

Z. MSCC: Mechanical Systems Controls Contractor

AA. MSTP: Master/Slave Token Passing

BB. OIS: Operator Interface System

CC. PICS: BACnet Protocol Implementation Conformance Statement

DD. SI: Systems Integrator

EE. UC: Unitary Controller

1.4 SYSTEM DESCRIPTION

A. Demolition Work: The MSCC shall visit the job site prior to, and during, the demolition phase to clearly identify and protect control tubes, wires and devices necessary to keep the remaining systems active during the project phasing. Post construction demolition relative to control infrastructure shall be coordinated by this contractor with the construction manager and demolition contractor. All obsolete control equipment shall be removed from the site, unless otherwise noted on the drawings. The MSCC shall be responsible to ensure that any demolition activities involving existing site Controls Systems, field device networks, or Operator Interface Systems do not impact or alter the operation or performance of any existing site Systems or Equipment intended to remain.

B. New Work: Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required to complete the installation of the controls for equipment as indicated on the drawings and herein described.

C. Provide a Building Automation System (BAS) incorporating Direct Digital Control (DDC), equipment monitoring, and control consisting of microcomputer based DCC Panels interfacing directly with sensors, actuators and environmental delivery systems (i.e., HVAC units, boilers, etc.); electric controls and mechanical devices for all items indicated on drawings, a primary communication network to allow data exchange from DDC panel to DDC panel; microcomputer based Unitary DDC Controllers (UCs) interfacing with sensors, actuators, and terminal equipment control devices; and a secondary communication network interfacing UCs to DDC panel network devices. The system shall be based on industry standard open protocols.

1. The Mechanical Systems Controls Contractor (MSCC) shall furnish and install a networked system of HVAC controls. The contractor shall incorporate direct digital control (DDC) for central plant engineering, building ventilation equipment, supplemental heating and cooling equipment and terminal units.
2. Provide networking to new DDC equipment using communication standards. System shall be capable of BACnet communication according to the most recent version of ASHRAE standard ANSI/ASHRAE 135 for interoperability with smart equipment and for the main IP communication trunk to the BAS server. The system shall not be limited to only standard protocols but shall also be able to integrate to a wide variety of third-party devices and applications via drivers and gateways.
3. Provide standalone controls where called for on the drawings or sequences.
4. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer.
5. Furnish a complete distributed direct digital control system in accordance with this specification section. This includes all system controllers, logic controllers and all input/output devices. Items of work included are as follows:

    a. Provide a submittal that meets the requirements below for approval.
    b. Coordinate installation schedule with the mechanical contractor and general contractor.
    c. Provide installation of all panels and devices unless otherwise stated.
    d. Provide power for panels and control devices.
    e. Provide 120VAC circuits, wiring, and raceway as necessary to power all controllers and controls components. Power shall be provided from available circuits within the nearest available electric distribution panel.
    f. Provide all low voltage control wiring and raceway for the DDC system.
    g. Provide miscellaneous control wiring for HVAC and related systems regardless of voltage.
    h. Provide engineering and technician labor to program and commission software for each system and operator interface. Submit commissioning reports for approval.
    i. Participate in commissioning for all equipment that is integrated into the BAS (refer to commissioning sections of the equipment or systems in other parts of this specification).
    j. Provide testing, demonstration and training as specified below.

D. Provide on-site supervision, calibration and checkout of the control systems.

E. It is the responsibility of the Contractor to review the Drawings and specifications of all other trades concerning this project to determine what equipment is to be furnished and/or installed and/or connected by the Contractor in addition to that equipment called for in the project Specifications and Drawings.

F. Provide shop drawings as specified herein.

G. Provide guarantee as specified herein.

H. Provide classroom training instructions to Owner's operating and maintenance personnel as specified herein.

1.5 SUBMITTALS

A. Qualification Data:

1. Systems Provider Qualification Data:

a. Resume of project manager assigned to Project.
b. Resumes of application engineering staff and technicians assigned to Project.
c. Descriptions of past projects completed, demonstrating required experience with projects of similar scope, size, and complexity.

2. Manufacturer's qualification data.

B. Product Data:

1. Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
2. Include ASHRAE BACnet Conformance documents for each DDC system component (panel, zone controller, field devices, and operator workstation) proposed including the following:

a. PICS Document
b. BACnet Testing Laboratories Product Listing
c. BACnet Testing Laboratories Conformance Certificate

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
3. Details of control panel faces, including controls, instruments, and labeling.
4. Written description of sequence of operation.
5. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including leakage and flow characteristics.
7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
8. Listing of connected data points, including connected control unit and input device. Input/output point summary with recommended set points.
9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
11. Bill of materials to identify each control device.
12. A complete set of shop drawings shall be properly identified with the Engineer’s project number and title. Shop drawings shall be 11” x 17” size (minimum).

13. Show interface with Work under other Contracts. Clearly illustrate, identify and define all components, assemblies, subsystems, and systems; relationship, interface, function, action, setting accuracy, range, sequence of operation, normal and abnormal conditions.

D. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.

E. Maintenance Data: For equipment to include in the maintenance manuals specified in Division 01.

F. Warranties: Special warranties specified in this Section.

G. No work shall be executed until the final submittals are approved by the project AE.

H. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise and submit Shop Drawings to reflect actual installation and operating sequences.

1.6 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details prior to installation.

B. Coordinate with the Mechanical Contractor for equipment provided with packaged controls including but not limited to field installation, wiring, and configuration of any supporting devices as necessary, and to complete integration to packaged unit controllers where indicated.

C. Coordinate with any auxiliary systems contractors to complete integration of auxiliary systems (ie. Laboratory Controls, Lighting Controls, Power Monitoring, Security, etc.) into the central site Operator Interface system.

D. Coordinate locations and requirements for IT Data connections with the Technology Contractor.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project, including a minimum of 2 years of documented experience with projects of similar scope and complexity.

B. Manufacturer Qualifications: A company experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance, including a minimum of 5 years of documented experience.

C. Install all BAS components, devices, and wiring in compliance with NEC and all local electrical codes.

D. 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.

E. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

F. Comply with ASHRAE 135 for DDC system control components.

1.8 DELIVERY, STORAGE AND HANDLING

A. In strict compliance with the manufacturer’s written instructions and recommendations, materials shall be provided to ensure that all equipment and components are completely protected from damage, dirt, or weather during shipping, storage, prior to installation, and after installation for the duration of the construction activities.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.9 WARRANTY

A. Contractor guarantees that this installation is free from defects and agrees to replace or repair, free of any charge to the satisfaction of the Owner's Representative any part of this installation including all components, parts and assemblies of the System which may fail within a period of one (1) year after final acceptance, provided that such failure is due to defects in the materials or workmanship or due to a failure to follow the specifications and drawings. The Contractor shall file with the Owner any and all guarantees from the equipment manufacturers and what operating conditions and performance capacities they are based on.

B. The Contractor shall initiate the warranty period by formally transmitting to the Owner commencement notification of the period for the system and devices accepted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers of DDC Controllers and accessories, subject to compliance with requirements of this specification and the project Drawings:

1. ABB (Formerly Cylon, American Automatrix)

B. Acceptable Mechanical Systems Controls Contractors:

1. Tri City Controls
   1229 Weiss St #B
   Frankenmuth, MI 48734
   (989) 652-2313

C. The MSCC shall be responsible for the complete installation of the system with full responsibility for proper operation including design, installation, checkout, testing, commissioning and warranty as herein described.

2.2 GENERAL

A. The MSCC shall provide a complete mechanical controls system including but not limited to programming, DDC controllers, software, sensors, transmitters, control valves, dampers, power supplies and wiring, network, gateways, routers, and all other devices required for a complete system.

B. The MSCC shall integrate all new controls into the existing Owner common ABB Aspect Enterprise BAS Operator Interface system to facilitate remote monitoring and control of mechanical controls systems including but not limited to developed system graphics, point monitoring, point commanding, point trending, equipment operation schedule management, and system alarm configuration and annunciation.

C. The MSCC shall provide a BACnet IP and/or MSTP field/floor level network or networks and shall connect all field devices to a BACnet B-BC controller or controllers. The B-BC controller(s) shall communicate with the BAS Operator Interface system server via the Owner’s IP network.

D. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, expansion modules, and operator devices.

E. System network architecture shall be completed such that each BAS controller shall operate independently by performing its own specified control, I/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

F. Systems requiring multiple controllers (ie. large chilled water plants) shall not utilize the Owner IP network for communication between common system controllers.

G. All controllers within a building shall be able to access any data from, or send control commands directly to, any other DDC controller or combination of controllers in the same building without dependence upon a central processing device (peer-to-peer).

H. All connected devices and systems must meet minimum Owner IT security requirements. The MSCC is responsible for remediation of any network security vulnerabilities identified by the Owner's IT department during the construction period and up to 1 year after project substantial completion.

2.3 OPERATOR INTERFACE SYSTEM

A. General

1. The MSCC shall integrate all new controls to the existing Owner common Operator Interface System for central, remote management and monitoring of connected BAS devices.
2. The MSCC shall review site network security requirements with the Owner's designated IT Support contact person and shall provide network security software and hardware components as necessary to meet site security requirements. Additionally, the MSCC shall provide network security software and hardware components as necessary to properly secure the BAS network and devices from other LAN connected devices.

B. Systems Integration: The MSCC shall complete integration of all devices indicated in the project Drawings and Specifications for integration into the common central Operator Interface System, including but not limited to Mechanical Systems Controls, Laboratory Controls, Lighting Controls, Power Monitoring, Fire Alarm System, and Security Systems.

1. Points: Available points from connected field devices shall be integrated into the central Operator Interface System as follows:

   a. Mechanical Infrastructure Systems: Integrate all available points
   b. Mechanical Terminal Equipment and Packaged Equipment Controllers: Integrate all physical device input and output points, as well as system virtual setpoints and other control points as necessary to enable appropriate equipment operation and monitoring by central system operators. All available system points are not required for integration.

2. Graphics: Graphics shall be created and organized to allow a system operator to fully navigate system graphics via graphic buttons. Graphics shall include the following:

   a. Homepage including a map view of and click link buttons to all Owner sites connected to Operator Interface System.
   b. Homepage for each building including building photograph and click button links to all connected central building equipment equipment, or equipment summary pages, and links to building floorplan graphics.
   c. Graphics shall include uploaded building keyplan style floorplans for all building floors including room numbers. Floorplan graphics shall include key information (ie. room temperature) from and click button links to terminal equipment associated with each room.
   d. Do not display extraneous points (not pertinent) on viewable graphics or display screens.
   e. Written sequence of operation shall be included and shall be click linked to the associated equipment or system graphic for reference.
   f. For each building, include a comprehensive network architecture riser diagram including all connected devices for the site and showing connection to the central Operator Interface System server. Diagram shall indicate the active connectivity status of each connected device.
   g. All control contractor as built documents and product cut sheets shall be converted into .pdf files and made available through a link on the OIS graphics.
   h. Data to be displayed within a unique graphic shall be assignable regardless of physical hardware address, communication channel or point type. Graphics shall be on-line

programmable and under password access control. Points shall be assignable to multiple graphics where necessary to facilitate operator understanding of system operation and where specified. Graphics shall also contain calculated or "software" points. Each physical point and each point assigned to a graphic shall be assigned an English descriptor for use in reports.

i. Points shall be displayed with dynamic data provided by the system with appropriate text descriptor, status or value, and engineering unit. Coloration shall be used to designate status and alarm states. Coloration shall be variable for each class of points, as chosen by the Owner.

j. An on-line "help" utility shall be provided to facilitate operator training and understanding. The "help" utility shall contain text and graphics to clarify system operation. At a minimum, help shall be available for every menu item and dialogue box.

3. Trends: System point trends shall be configured for connected systems as follows:

a. Central Mechanical Equipment: Include trending for all main system points such as temperature, pressure, flow, valve command, damper command, setpoints, motor command and status, etc. Trends shall be change of value (COV) based including a maximum 1 hour time interval between recorded point values.

b. Terminal Mechanical Equipment: Include trending for current room temperature, any unique terminal monitoring points such as carbon monoxide, carbon dioxide, etc., and any other critical terminal monitoring points as necessary.

c. Auxiliary Systems: Include minimum baseline trending of key system operational and monitoring points.

4. Alarms: Configure system alarms for monitoring of all key operational parameters of all central mechanical systems and auxiliary systems, and terminal equipment monitoring points as necessary. Several examples of required system alarm points are included below:

a. Fan or pump motor status does not match enable command for 10 seconds
b. Boiler or chiller status does not match enable command for 10 seconds
c. Equipment general alarm point has changed state to alarm status
d. Air Handling Unit freezestat has tripped
e. Air Handling Unit discharge air temperature is +/-5°F of setpoint during occupied mode
f. Air Handling Unit end of duct static pressure is +/-0.5” WC of setpoint during occupied mode
g. Air Handling Unit return air relative humidity is >70%RH during occupied mode
h. Hydronic system liquid temperature is +/-5°F of setpoint when the system is enabled
i. Hydronic system pressure is +/-5 psi of setpoint when the system is enabled
j. Space/room temperature is <50°F or >90°F
k. Area lighting status does not match enable command for 10 seconds

2.4 DDC CONTROLLERS AND ASSOCIATED COMPONENTS

A. DDC Controllers

1. All BAS controllers shall use the latest version of ANSI/ASHRAE Standard 135 BACnet standard for communications, have passed BACnet Testing Laboratories (BTL) certification and be listed as compliant with UL916 Standard for Energy Management Equipment. BAS controllers used in smoke control applications must also be listed as compliant with UL864 Standard for Control Units and Accessories for Fire Alarm Systems.
2. All controllers shall be listed by BTL as conforming to the required standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
3. BAS controller types shall be one of three types, a BACnet Building Controller (B-BC), a BACnet Advanced Application Specific Controller (B-AAC) or a BACnet Application Specific Controllers (B-ASC).

a. Building Controllers (B-BC) shall be used for all major mechanical equipment and/or systems (i.e. chilled water, heating hot water, large AHU’s, etc.).

b. Advanced Application Specific Controllers (B-AAC) shall be used, as an extension of a B-BC's performance & capacity, for control of all medium and small mechanical systems and/or terminal equipment.
c. Application Specific Controllers (B-ASC) shall only be allowed to be used on terminal equipment including VAV boxes, FCU's, etc.

4. BACnet Building Controller (B-BC):

a. Provide controllers conforming to the latest version of ANSI/ASHRAE 135 BACnet Building Controller (B-BC) standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
b. Controllers shall support Internet Protocol (IP) for communications to other BC's and the Operator Interface System and MS/TP communication to B-AAC's and B-ASC's.
c. Controllers shall have a 32 bit processor with an EEPROM, flash driven operating system. They shall be multi-tasking, multi-user, real-time digital control processors and permit I/O expansion for control / monitoring of up to 48 I/O. Controller size shall be sufficient to fully meet the requirements of this specification. Controllers shall be fully programmable while supporting standard energy management functions, including but not limited to:

1) Alarm detection and reporting
2) Automatic Daylight Saving Time switchover
3) Calendar-based scheduling
4) Closed loop PID control
5) Duty cycling
6) Economizer control
7) Equipment scheduling, optimization and sequencing
8) Event scheduling
9) Historical trend collection
10) Holiday scheduling
11) Logical programming
12) Reset schedules
13) Night setback control
14) Peak Demand Limiting (PDL)
15) Start-Stop Time Optimization (SSTO)
16) Temperature-compensated duty cycling
17) Temporary schedule override

d. Provide controller with integral power switch. If an integral switch is not provided by the manufacturer, the MSCC shall provide a separate dedicated transformer and switch within each enclosure for each controller present.
e. The operator shall have the ability to manually override automatic or centrally executed commands at the Building Controller via local, point discrete, hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points. These override switches shall be operable whether the panel processor is operational or not.
f. Controllers shall provide local LED status indication for power, communications, status and each digital output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
g. All points associated with a given mechanical system (i.e., an air handling unit) will be controlled from a single Building Controller or point expansion panel(s) from the respective master. All expansion modules shall be located in the building controller enclosure or an attached enclosure. No points from a given mechanical system may be distributed among multiple panels - points must be run back to a single Building Controller dedicated to that mechanical system. Multiple mechanical systems shall be allowed on a single controller. Closed-loop control must never depend upon network communications. All inputs, program sequences, and outputs for any single BAS control loop shall reside in the same Building Controller.

h. A variety of historical data collection utilities shall be provided for manual or automatic sampling, storing and displaying system point data.

1) Building Controllers shall store point history data for selected analog and digital inputs and outputs:

i. Building Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control. Provide capability to view or print trend and tuning reports.

1) Loop tuning shall be capable of being initiated either locally at the Building Controller or from a network workstation. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

j. Provide controllers that, upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.

k. Provide additional controllers or I/O modules if necessary in each BAS panel so that each panel has at least 20% spare universal I/O capacity for connection of future points. Provide all processors, power supplies, and communication controllers so that the implementation of adding a point to the spare point location only requires the addition of the appropriate expansion modules, sensors/actuators and/or field wiring/tubing.

l. Controllers shall provide at least one data communication port for operation of operator I/O devices such as portable laptop operator's terminals. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected printers or terminals. A USB port shall alternatively be available to support local HMI tools connection.

m. Field bus adaptors may be used, as an extension of the B-BC, to facilitate communication between the B-BC and remote field devices (sensors, actuators). Adaptors shall be microprocessor based and utilize advanced diagnostics and configuration. Adaptor shall be housed in panel or junction box enclosure.

n. Any provided JACE controllers shall be by Tridium Vykon and shall be fully open for Owner use and configuration without the need for any proprietary software or licenses.

5. BACnet Advanced Application Specific Controller (B-AAC):

a. Provide controllers conforming to the latest version of ANSI/ASHRAE 135 BACnet Advanced Application Specific Controller (B-AAC) standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.

b. Controllers shall support MS/TP communication to B-BC's and other B-AAC's and B-ASC's. Also acceptable are B-AAC controllers that support Internet Protocol (IP) for communications to other BC's/ AAC's and the Operator Interface System and MS/TP communication to B-AAC's/ ASC's.

c. Controller shall be a microprocessor-based, 32 bit, multi-tasking, real-time digital control processor capable of stand-alone operation for medium sized mechanical systems and/ or control of roof-top units, VAV terminal units, CAV terminal units, dual-duct terminal units, fan-coil units, heat pump units.

1) If the hardware point requirements of any medium-sized system should exceed the I/O configuration of available B-AAC offerings then a B-BC must be used. Control of one piece of mechanical equipment may not be performed by more than one controller.

d. Controllers shall be peer-to-peer devices with hand/off/auto switches for each digital output. Switch position shall be supervised in order to inform the system that automatic control has been overridden. Switches will only be required for non-terminal applications (not required for VAVs, CAV's and other above terminal devices). All inputs and outputs shall be of the universal type, allowing for additional system flexibility.

e. Each controller shall support its own real-time operating system. Controllers without real-time clock functionality will only be permitted for use on terminal or unitary equipment such as VAV boxes, fan coil units and auxiliary monitoring and control.
f. Provide each controller with sufficient memory to accommodate point databases and operating programs. All databases and programs shall be stored in non-volatile EEPROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
g. Controllers must be fully programmable. All programs shall be field-customized to meet the user's exact control strategy requirements. Controllers utilizing pre-packaged or canned programs shall not be acceptable.
h. All points used for a single mechanical system shall be connected to the same B-AAC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.
i. Provide spare additional I/O such that future use of spare capacity shall require providing only the field device, field wiring, point database definition and operational sequence programming changes as required. Additional point modules may be required to implement use of these spare points.

1) Provide at least one (1) spare universal input and one (1) spare universal output or 15% spare I/O of the total capacity of each B-AAC whichever is greater.
2) If B-AAC I/O is not universal then provide at least one (1) spare analog input, one (1) spare digital input, one (1) spare analog output and one (1) spare digital output or 15% spare I/O of the total capacity for each point type of each B-AAC whichever is greater.

6. BACnet Application Specific Controller (B-ASC):

a. Provide controllers conforming to the latest version of ANSI/ ASHRAE 135 BACnet Application Specific Controller (B-ASC) standard device profile and support all of the minimum required BACnet Interoperability Building Blocks (BIBBs) associated with this device profile.
b. Controllers shall support MS/TP communication to B-BC's, B-AAC's and other B-ASC's.
c. Controller shall be a microprocessor-based, 32 bit, multi-tasking, real-time digital control processor capable of stand-alone operation for control of mechanical terminal units, i.e. VAV terminal units, CAV terminal units, air terminal units, dual-duct terminal units, fan-coil units, heat pump units and roof-top units.
d. Each controller shall be capable of sharing point information with other B-BC, B-AAC, or B-ASC on a peer-to-peer basis via the BACnet network.
e. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. All inputs and outputs shall be of the universal type (outputs may be utilized either as modulating or two-state). Analog outputs shall be industry standard signals such as 24V floating control and 0-10VDC allowing for interface to a variety of modulating actuators.
f. Provide each controller with sufficient memory to accommodate point databases and operating and application programs. All databases and programs shall be stored in non-volatile EEPROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
g. Each controller shall perform its primary control function independent of other BAS controller communications, or if communication is interrupted. Reversion to a fail-safe mode of operation during network interruption is not acceptable. Controller shall receive its real-time data from the Building Controller time clock to ensure network continuity.
h. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) values for all applications. All PID values and biases shall be field-adjustable by the user via operator terminals.
i. Controllers shall provide diagnostic LEDs for power, communications and processor status. The controller shall continually check the status of its processor and memory circuits
j. All points used for a single mechanical terminal unit shall be connected to a dedicated B-ASC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.

k. Controllers shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second. Controller shall store point history files for all analog & binary I/O's.

7. Controllers used for air terminal units (VAV's, CAV's, dual-duct mixing boxes):

a. Provide electronic damper operators compatible with the controller and the air terminal units provided. Actuator shall utilize a brushless DC operator, min 35 in-lbs. of torque, floating control (unless noted otherwise).
b. Controllers shall have an internal differential pressure transducer(s) capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Transducer shall be capable of 5% accuracy throughout its range of 0-1"wc. Associated velocity sensor shall be furnished by air terminal unit manufacturer.
c. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable.
d. Provide a discharge air sensor, mounted on the discharge of the terminal box reheat coil and/ or the outlet of dual duct mixing boxes, interfaced with the controller.
e. Each controller shall include provisions for automatic calibration of the differential pressure transducer in order to maintain stable control and prevent drift over time. The method of stroking the terminal unit damper to a 0% position shall not be permitted should the controlled space(s) require constant pressurization that would be compromised if the controller would require closing the VAV box damper. MSCC shall provide alternate controllers, programming and/or auxiliary devices (i.e. an 'auto-zero' auxiliary device(s) which functions to temporarily disengage the transducer from the air velocity sensor so that a 0 cfm air volume reading is forced without changing the damper position) when serving these spaces to prevent negatively affecting room pressurization.
f. If coordinated with mechanical contractor, controllers shall be furnished to the unit manufacturer for factory mounting; otherwise, controls shall be field installed.
g. MSCC shall provide controllers with metal enclosure, complete with conduit knockouts.

8. Provide and fully implement the following application function (algorithms) in the BAS Panel. The following functions shall be operator assignable to each BAS Panel.

a. Time and Calendar based Scheduled Operation
b. Automatic daylight savings time switchover
c. Optimum Start/Stop
d. Night Cycle Program
e. Night Purge Program
f. Reset Program for Set point Adjustment
g. Ventilation (Economizer) Program
h. Analog and Binary
i. Energy Calculations
j. Software Interlock
k. Trouble Diagnosis
l. Direct digital control loops for temperature control functions

B. Panel enclosures

1. Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Enclosures shall not be mounted directly on HVAC equipment such as air handling unit housings. Provide common keying for all panels.

a. Fabricate panels of 0.06 inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.

C. Networking devices

1. BACnet IP Routers:

a. BACnet router between MS/TP and B/IP (BACnet over IP) as well as a BBMD (BACnet Broadcast Management Device) for transportation of BACnet broadcasts over an IP network with several subnets.
b. Router shall comply with latest version of ASHRAE Standard 135 for communications.
c. Routers shall be UL864 listed when connected to BACnet MS/TP network segments that contain UL864 listed devices being used in a smoke control application.
d. Device shall be capable of routing BACnet packets over layer 3 IP network and shall support both the router and BACnet Broadcast Management Device (BBMD) networking options. BBMD shall support registrations by Foreign Devices.
e. 24 VAC power supply required for router(s) shall be provided by the MSCC.
f. Device shall be password protected with customizable password and security settings.

D. Power supplies

1. Power to controllers and associated controlled devices shall be 24 VAC, provided by the MSCC. Unless otherwise noted, power source (i.e. normal vs. emergency power) shall match that of the equipment being controlled.
2. Provide each DDC panel with a line filter, surge suppressor, electrical disconnect, control fuse, and control transformer. All sized and provided by the MSCC.
3. Provide fully enclosed power supplies located inside control enclosures with external 24 Vac terminals, on/off control, equipment overcurrent protection, power indication, high/low voltage separation, and convenience 120VAC outlets.
4. Provide insulated, modular, feed-through, clamp-style terminal blocks suitable for rail-mounting with end plates and partitions for the termination of all field wiring in control enclosures. Field wiring to equipment with integral terminals and/or unitary equipment (i.e., VAV's, EF's, etc.) shall not be required to have terminal blocks.
5. Provide a minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger. The backup power source shall have sufficient capacity to maintain volatile memory in event of an AC power failure.

2.5 ACTUATORS AND OPERATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action as indicated.

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
2. Non-spring Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
3. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
4. Non-spring Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
5. Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Damper or Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch pounds/sq. ft. of damper.

b. Opposed-Blade Damper with Edge Seals: 5 inch pounds/sq. ft. of damper.
c. Parallel-Blade Damper without Edge Seals: 4 inch pounds/sq. ft of damper.
d. Opposed-Blade Damper without Edge Seals: 3 inch pounds/sq. ft. of damper.
e. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1,000 to 2,500 FPM: Multiply the minimum full-stroke cycles above by 1.5.
f. Dampers with 3 to 4 Inches wg of Pressure Drop or Face Velocities of 2,500 to 3,000 FPM: Multiply the minimum full-stroke cycles above by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
6. Temperature Rating: Minus 22 to plus 122 deg F.
7. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
8. Run Time: Maximum 90 seconds
9. Fast Acting Actuator Run Time: Maximum 10 seconds

2.6 CONTROL VALVES

A. Valves shall be provided according to the details of this section, and in compliance with the related specification section “Valves”.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Globe Valves NPS 2 and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.

D. Globe Valves NPS 2-1/2 and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

E. Hydronic system globe valves shall have the following characteristics:

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.

a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.

3. Sizing: 3 psig maximum pressure drop at design flow rate.
4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall be sized to close valves against pump shutoff head.

F. Steam system globe valves shall have the following characteristics:

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Internal Construction: Replaceable plugs and seats of stainless steel.

a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.

3. Sizing: 10 psig inlet pressure and 5 psig pressure drop.
4. Sizing: Pressure drop across steam valve at a maximum flow of 80 percent of inlet pressure for low-pressure systems and 42 percent for high-pressure systems.
5. Flow Characteristics: Modified linear characteristics.

G. Butterfly Valves: 200 psig, 150 psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

1. Body Style: Lug.
2. Disc Type: Aluminum bronze.
3. Sizing: 1 psig maximum pressure drop at design flow rate.

H. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 3 psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

I. Self-Contained Thermostatic Radiator Control Valve

1. Rating: 125 psig and 250 deg F operating conditions
2. Valve shall be selected and sized accordingly for the applicable Hot Water or Steam system application.
3. Valve body shall include packing gland assembly that is replaceable while the system is in operation.
4. Valve shall be provided with integral thermostatic operator including an ambient air temperature sensor and space temperature setpoint adjustment dial capable with a setpoint range of at least 60 deg F to 85 deg F.
5. Contractor shall review the application and shall provide valve mounted operator and dial or remote mounted dial and sensor with capillary tube as necessary for proper temperature control and user temperature adjustment access.
6. Manufacturer: Danfoss (or approved equal)

2.7 CONTROL DAMPERS

A. Dampers: AMCA-rated, airfoil type parallel and opposed-blade design by an ISO 9001 accredited manufacturer; 13 gauge minimum, galvanized-steel frames; damper blades shall not be less than 16 gauge galvanized steel or aluminum with maximum blade size of 8 inches wide and 48 inches long.

1. Unless otherwise noted, dampers intended for two position operation shall be parallel blade, and dampers intended for modulating control shall be opposed blade.
2. Face and bypass dampers shall be sized to pass 100% of the associated unit rated airflow.
3. Provide required drive axles, linkage, jackshafts, and accessories for proper damper operation. All linkages shall be located outside of the airstream.
4. Damper blades, frames, linkages, jackshafts and other parts of the damper actuation system shall not distort or rack during operation.
5. Dampers shall close tightly, and operate in a smooth, hesitation and slack-free manner over the entire range of travel, at the maximum air pressure and velocity at the mounting location.
6. Multiple section dampers shall operate in unison section-to-section.
7. Dampers shall include blade and edge seals as necessary to achieve maximum leakage of 4 CFM per sq. ft. of damper area at 1.0” WC pressure.
8. Operating Temperature Range: From minus 40 to plus 200 deg F.
9. Static Pressure Rating: Shall be selected to withstand the maximum pressure to be encountered upon closure at the installation location, but not less than 4.0” WC.
10. Dampers shall be supported by properly reinforcing the ductwork at damper locations to carry the weight of the dampers, or shall be supported independent of ductwork, from the structure or floor as conditions at the site dictate. Both sides of damper frame shall be caulked.

11. Dampers which will be exposed directly to weather shall have stainless steel axles, bearings, bushings, and fittings. Dampers which open directly to outdoors from a room such as mechanical or electrical room ventilation, shall include 1" of 1-1/2 lb. density insulation sandwiched in 16 gauge zinc coated steel blades. Bearings shall be oilite bronze.
12. Manufacturers: Dampers shall be Ruskin, Vent Products, or approved equal. Use insulated dampers as indicated on the drawings.

2.8 TEMPERATURE & HUMIDITY INSTRUMENTS

A. Temperature Sensors

1. Resistance Temperature Detectors (RTD): Platinum.

   a. Single point duct mounted RTD shall be rigid bulb type, with probe length selected accordingly for measurement near center of the duct cross sectional area
   b. Averaging point duct mounted RTD sensor probe(s) shall be selected to appropriately cover the full duct/coil cross sectional area at the location of installation
   c. Outside air RTD shall have sun shield to minimize solar effects and shall be mounted to minimize building outside air film effects
   d. Immersion Type - shall be suitable for immersion into fluids in pipes with separable well and heat transfer compound, which shall be compatible with the sensors
   e. Space temperature with a range of 55 to 85 degF, plus or minus 0.5 degF, for conditioned space. Space temperature sensors installed at building exterior entrances shall include temperature sensing down to 20 degF for freeze risk monitoring.
   f. Duct temperature with a range of 20 to 120 degF, plus or minus 0.5 degF, or 30 to 250 degF for heating applications
   g. Outside Air (OA) temperature with a range of minus 40 to plus 130 degF, plus or minus 2 degF
   h. Liquid immersion temperature sensors shall include probe with SS well, and weather tight enclosure. Sensors shall include a calibrated span of 20 to 120 degF or 30 to 250 degF for heating applications.

2. Sensors installed in wet service locations (ie. natatorium, piping tunnels, etc.) shall be waterproof and shall be resistant to chlorine and other cleaning agents. Sensors shall have rust proof and waterproof covers.

B. Low-Limit Temperature Protection (Freeze-Stat)

1. Freeze detection controller shall open a switch (auxiliary contact for BAS alarm indication) in series with fan starter holding coil when temperature falls to controller setpoint. Controller shall be equipped with a minimum of 20 feet of copper capillary tube, which shall be placed to the downstream face of the protected coil. Controller shall be manually reset and shall open the circuit when any 12" length of the capillary reaches setting temperature. Install capillary in a horizontal pattern only. Use multiple detectors as required, do not exceed the manufacturer’s maximum coverage area. Use one thermostat for every 20 sq. ft. of coil surface. Install freezestat on face and bypass coils precisely per the face and bypass manufacturer's instructions. The capillary tube shall cover only one vertical section of coil and shall not extend across any bypass portion.

C. Humidity Sensors

1. Humidity sensor shall use a thin film capacitive sensing element to measure the relative humidity (RH) over a range of 0% to 100% RH. Accuracy shall be +/-2% RH.
2. Humidity transmitters shall be suitable for one or more of the following mounting methods:

   a. Room Type: Shall be suitable for wall mounting with enclosure where located in a finished space.
   b. Insertion Type: Shall be suitable for insertion into air ducts at any angle, and shall have a minimum insertion of 6 inches.

3. Sensors installed in wet service locations (ie. natatorium, piping tunnels, etc.) shall be waterproof and shall be resistant to chlorine and other cleaning agents. Sensors shall have rust proof and waterproof covers.

D. Thermostat

1. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-position, push-button or lever-operated fan switch. These line voltage thermostats control heating, cooling or year round air conditioning units in commercial, industrial or residential installations. Typical uses are for unit heaters, fan coils, blast coils, refrigerated storage room, electric heat, duct furnaces, greenhouses, etc.

   a. Concealed auto-off-fan selector switch
   b. Thermostat shall be placed where air circulates around it freely
   c. Never install the thermostat on or near an outside wall
   d. Keep the thermostat away from windows and doors
   e. Do not locate the thermostat away from windows and doors
   f. Do not locate the thermostat too close to a strong light or any other false source of heat such as direct sunlight, steam lines, etc.
   g. Mount the thermostat on a post or partitioning wall, but make sure that there are no pipes or ductwork in that wall or in the other side of the wall
   h. Mount in a vertical position

2. Electric solid-state, microcomputer-based room thermostat.

   a. Automatic switching from heating to cooling
   b. Preferential rate control to minimize overshoot and deviation from set point
   c. Set up for four separate temperatures per day
   d. Instant override of set point for continuous or timed period from 1 hour to 31 days
   e. Short-cycle protection
   f. Programming based on [weekdays, Saturdays and Sundays] [every day of week]
   g. Selection features include deg F or deg C display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto
   h. Battery replacement without program loss
   i. Thermostat display features include the following:

      1) Time of day
      2) Actual room temperature
      3) Programmed temperature
      4) Programmed time
      5) Duration of timed override
      6) Day of week
      7) System mode indications include "heating," "off," "fan auto," and "fan on"

3. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
4. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.

   a. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.

      1) Dead Band: Maximum 2 deg F.

5. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

6. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

E. Outside air sensors shall be installed away from exhaust or relief vents, shall not be installed in an outside air intake, and shall generally be located to provide the best possible sensing of actual outside air conditions, free from influence from the building or operational activities. Sensors shall be installed on a North exterior building wall or an otherwise continuously, year-round shaded location. Outside air temperature sensor shall be provided with a sun shield.

2.9 ELECTRICAL COMPONENTS AND ACCESSORIES

A. Components

1. Control Relays

a. Control relays shall be provided with two spare, unused contacts, one normally opened and the other normally closed.
b. All relays shall be plug-in interchangeable mounted on a circuit board and wired to numbered terminal strips.
c. Start/stop relay module shall provide either momentary or maintained switching action as appropriate for the motor being started.

2. Current Switches

a. Current Sensing Switches (CS): CS shall be utilized for monitoring motor operation. Switch shall be adjustable so that a contact closure is made any time the motor is operating within a “normal” range (1.25-50 amps). Low motor amps resulting from low loading or belt failure shall indicate “OFF”. Induced current from the motor power feed shall power CS. The CS shall provide visual indication (LED’s) for output status and sensor power; shall have an adjustable trip set-point to ± 1% of its range from -15 to 60°C; shall be isolated to 600 VAC rms; shall be a self gripping split-core type with an optional drill mount bracket; output shall be N.O., solid state, 1.0 A at 30 VAC/DC with a minimum aperture of .52” x .68” for motor power feed. CS shall be a Hawkeye model #H-608 as supplied by Veris Industries, Inc. or equal.
b. Motor Status: The contractor shall provide and install a current sensing switch on any motor required to have motor status. The split-core current switch shall be clamped around one of the three phase motor conductors. The contractor shall adjust the switch per the manufacturer’s recommendations to provide status only when the motor driven device (fan, pump, etc.) is operating normally.

B. Wiring and Conduit

1. Control wiring and cabling shall be per equipment manufacturer's recommendation and requirements of the mechanical control systems.

2.10 PNEUMATIC COMPONENTS AND ACCESSORIES

A. Tubing

1. Copper tubing shall be new hard drawn, air grade, ASTM B75 for 3/8 inch and smaller or type L, ASTM B68 for 1/2 inch and larger, with solder joint or compression type fittings, at the option of the MSCC.
2. Plastic tubing (all sizes) shall be black virgin, polyethylene, ASTM D1248, Type 1, Class C, Grade 5, meeting crack test performance required by ASTM D1693 and be fire retardant (FR) rated. Multi-tube harness material shall be as specified above with a polyester film barrier and vinyl jacket not less than 0.062 inches thick. All non-metallic tubing shall be 1/4" O.D. minimum; micro-sleeve is not acceptable.

B. Differential Pressure Gauges

1. Description:

a. 2000 Series magnahelic differential pressure gauges shall provide an accurate indication of positive, negative, or differential air pressure. The gauge shall include a 4" (10.2 cm) easy to read dial and frictionless magnetic movement in cast aluminum housing and be resistant to shock, vibration, and overpressure. The 2000 Series has both back and side connections so that it may be either surface or flush mounted. Ranges are available from 0" to 0.25" W.C. up to 10" W.C. Select gauge for normal reading to be not less than 25% of full scale.

2. Features:

a. 2% full scale accuracy
b. Easy to read 4" (10.16 cm) white dial and red tipped pointer
c. Flush or surface mounting
d. Easily accessible zero adjustment
e. Corrosion resistant cast aluminum housing
f. Back and side connections

3. Specifications:

a. Accuracy: ± 2% of FS (3% on -0 and 4% on -00 ranges) throughout range @ 70 °F (21 °C).
b. Overpressure: Relief plug designed to open at 25 psig (172 kPa).
c. Ambient Temperature: 20 °F to 140 °F (-7 °C to 60 °C).
d. Rated Total Pressure: -20" Hg to 15 psig (103 kPa).
e. Connections: 1/8" NPT female high and low pressure taps, duplicated-one pair side and one pair back.
f. Housing: Die-cast aluminum, case and aluminum parts iridate-dipped to withstand 168 hour salt spray test, baked dark gray hammerloid exterior finish.
g. Standard Accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.
h. Weight: 1.0 lb. (2.0 oz).
i. Warranty: 1 year.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Label every single control device and component including, but not limited to, space sensors, well sensors, AFS's, control panels, damper actuators, VAV box controllers, valves, outdoor air sensors, relays, pressure sensors, differential pressure transmitters, pressure switches, etc. Label must include plain English descriptor and BAS point ID that matches the ID on the OWS exactly.

B. Verify that conditioned power supply is available to control units and operator workstation.

C. Verify that duct-, pipe-, and equipment-mounted devices and wiring and pneumatic piping are installed before proceeding with installation.

3.2 COMMISSIONING

A. This contractor shall make available a qualified technician that is familiar with the installation of this job for technical assistance to the commissioning engineer. No additional paperwork or reports will be required by this process. Where multiple operations in multiple locations are required to test equipment affected under this contract, the appropriate number of staff shall be required.

3.3 INSTALLATION

A. Install equipment level and plumb.

B. Install software in control units and Operator Interface System. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve the sequence of operation specified.

D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards on thermostats in the following locations:

1. Entrances
2. Public areas
3. Where indicated

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Control wiring in exposed areas and within walls shall be in conduit or EMT as specified in the Electrical Requirements - Division 26.

B. Low voltage control wiring in plenum areas and ceiling cavities shall be plenum rated cable installed parallel or perpendicular to the building structure. Install control wire in bridle rings every 10' and change in direction. Label control wire as such at each bridle ring. **This item will be strictly enforced.**

C. Space sensor wires that cannot be run within a wall cavity shall be run in one-piece steel surface raceway (Wiremold V500 or equal) and painted to match the existing finish. Fill and patch any cavities left by previous sensors. Paint to match existing finish.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 SENSORS, RELAYS, CONTROLS AND ASSOCIATED COMPONENTS

A. Location – Accessibility:

1. Locate controls, relays, instruments, switches, valves, devices and accessories so they are readily accessible for adjustment, service and replacement or as indicated. Conceal tubing, sensing lines, cables and capillaries in all areas except equipment rooms and other unfinished spaces. Install and route tubing, sensing lines, cables, capillaries and conduits parallel and perpendicular to building steel in parallel banks with changes of direction made at 90 degree angles.

B. Location – Sensing Air:

1. Locate, size, and support temperature sensing elements in air streams to properly sense the representative temperature. In the case of controlling, transmitting and indicating elements, the sensing device shall be located, sized and of the type to sense the average condition. In case of safety elements, the sensing device shall be located and of the type to sense the extreme condition.
2. Sensing elements in double wall casings and insulated ducts shall have the entire active portion within the air stream.

C. Insulation:

1. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Where control devices are to be located on insulated surfaces, provide brackets to clear the finished surface of the insulation avoiding punctures of the vapor seal.

3.7 VIBRATION ISOLATION

A. Components:

1. Provide vibration isolation for controllers and components, either by location or by mounting devices.

B. Conduit and Tubing:

1. Install tubing and conduit to preclude nullification of provisions for vibration isolation of equipment and ducting. Mount single tube runs in aircraft type clamps containing an elastomer insert. Mounting shall prevent contact with ducting and air handling unit housing, casing or enclosure. Multiple runs shall conform to the same isolation requirements but details of mounting shall be submitted for approval. Provide looped rubber hose connection when tubing crosses flexible duct and equipment connectors.

3.8 FASTENING TO BUILDING STRUCTURES

A. The methods of attaching or fastening equipment or equipment supports or hangers to the building structure shall be subject to approval by the AE. Submit shop drawings or samples for approval before proceeding with the work.

B. Drilling, welding or the use of explosive driven fasteners on building structures shall require written prior approval by the AE for each type of application except where indicated.

C. Equipment shall not be attached to or supported from the roof deck, from removable or knockout panels, or temporary walls or partitions.

D. Electrical equipment mounted against exterior masonry walls shall be mounted at least 1 inch away from the wall surface.

3.9 FIELD QUALITY CONTROL

A. After the inspection has been completed, check systems for continuity.

B. After completion of system installation, the Contractor shall test, adjust, and readjust as necessary, all control equipment in terms of design, function, systems balance, performance, and otherwise make ready for air handling systems acceptance tests.

C. After systems acceptance and after the systems have operated in normal service for two weeks, check the adjustment on instruments and devices and correct items found to be out of order. When systems are in specified operating condition, and other pertinent specifications have been complied with, temperature control systems will be accepted for heating, ventilating and air conditioning systems. Readjustments necessary to accomplish the specified results shall be made during the warranty period upon request.

D. Coordinate with system manufacturer's representative the time of the final system check.

E. Provide equipment to check the calibration of instruments. Instruments not in calibration shall be recalibrated to function as required, or shall be replaced.

F. Calibrate and adjust control devices, linkages, accessories, and components for stable and accurate operation to meet the design intent and to obtain optimum performance from the equipment controlled. Final adjustment, calibration and checking shall be performed while the respective controlled systems are in full operation. Cause every device to automatically function as intended to ensure its proper operation.

G. After calibrations, adjustments, and checking have been completed and systems are operational, demonstrate to the administrative authorities having jurisdiction and to the AE the complete and correct functioning of all control systems and equipment. These demonstrations shall consist of operating the controls through their normal full ranges and sequences. Simulate abnormal conditions to demonstrate proper functioning of safety devices. Readjust settings to their correct design values, and after sufficient time, observe ability of controls to establish the desired conditions, noting abnormal deviations. Make necessary repairs, replacements or adjustments on items which fail to perform satisfactorily and repeat tests to demonstrate compliance with the design intent.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.
3. Review data in maintenance manuals.
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.11 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.12 OWNER’S INSTRUCTION

A. The MSCC shall Provide a training program encompassing equipment and systems for client's operating and maintenance personnel. Coordinate training schedule with the Owner.

B. Training staff shall include Contractor's personnel supplemented by equipment manufacturer's engineering representative.

C. Utilize corrected equipment and system shop drawings, manuals, demonstration apparatus and installed, functioning equipment.

D. During system commissioning and when acceptable performance of the system hardware and software has been established, provide on-site operator and maintenance personnel instruction. Instruction shall be by acceptable competent Contractor Representatives familiar with the systems and computer software, hardware, and accessories.

E. Provide 4 hours of "classroom" instruction to the client's personnel on the operation of DDC System equipment. Operator instruction shall include the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the systems operation. Use the operating and maintenance manuals described above as texts during the instructional period. Instruction shall also include description of the chronological information flow from field sensors, contacts and devices to the DDC System. The overview of the system's communication network shall be to provide an understanding to the client's personnel of the interplay between initiating devices, data gathering locations, loop communications and their importance within the DDC System.

END OF SECTION 23 0900

SECTION 23 2513 – CHEMICAL WATER TREATMENT, CLOSED LOOP WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

B. Related Sections:

1. Section 20 0500 - Common Work Results for Mechanical
2. Section 20 1113 - Piping Materials and Methods
3. Section 20 0523 - Valves
4. Section 20 0519 – Thermometers, Pressure Gauges, and Accessories
5. Section 20 0553 - Mechanical Identification
6. Section 20 0719 - Mechanical Systems Insulation

1.2 SUMMARY

A. Products specified in this section include the following:

1. Chemicals for Inhibitors and cleaning

B. Provide a Chemical Services Provider (CSP) to perform the services described below.

C. Provide water treatment products and services including:

1. Chemicals for cleaning, passivation, and treatment of each system.

D. Provide a complete chemical water treatment program during construction for all piping networks. This program shall begin from the point each system is filled during construction and extend until Substantial Completion or final Owner acceptance of each system, whichever occurs later. The program shall include water analysis, chemicals, testing, equipment, consulting and service for the following systems:

1. Heating Hot Water System

E. Attend project meetings as required to plan, schedule and coordinate above activities with other project contractors and the Owner.

F. Coordinate with Owner's personnel & Chemical Treatment provider to allow for treatment adjustments of the central Heating Hot Water System impacted by the drain and re-fill of new HWHS & R piping used in the Project equipment & piping.

1.3 SUBMITTALS

A. Product Data: Include rated capacities; water-pressure drops; shipping, installed, and operating weights/volumes; and complete data on furnished products listed below:

1. Product specifications and MSDS's for each chemical used
2. Cleaning Procedures
3. Passivation Procedures
4. Chemical Treatment Procedures
5. Shop Drawings

B. Submit resume of water treatment personnel and name of Chemical Services Provider.

C. Service Reports as indicated under Part 2 below.

1.4 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1. American Society for Testing and Materials (ASTM)

a. D859 – Test Method for Silica in Water
b. D1067 – Test Methods for Acidity/Alkalinity in Water
c. D1068 – Test Methods for Iron in Water
d. D1126 – Test Method for Hardness in Water
e. D3370 – Practices for Sampling Water from Closed Conduits
f. D4012 - Test Method for Adenosine Triphosphate (ATP) Content of Microorganisms in Water
g. D5465 - Practice for Determining Microbial Colony Counts from Waters Analyzed by Plating Methods

C. Conform to all applicable Codes, Regulations, and Municipal requirements for the use and disposal of chemicals (including cleaning compounds) and waste to public sewer systems.

1. Wastewater shall be discharged to the sanitary sewer only if it has a pH between 5.0 and 10.0 and meets the requirements of the City of Caro.

D. Wastewater containing any chemical or sediment is prohibited from discharge to the storm water system. No chemical shall contain Chromates or Inorganic Phosphates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package for delivery to best protect finished surfaces while using the least amount of single-use packaging as possible. Deliver equipment and components adequately packaged for lifting, skidding, or rolling into final position, according to manufacturer's instructions. If possible, package and ship products using reusable blankets and fabrics, or reusable cardboard and crate systems.

B. Store materials and equipment raised off the floor on pallets and protected with coverings to prevent damage due to weather and construction activities. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

C. Store chemicals in curb protected area. Such secondary containment areas must have the capacity to hold the volume of the largest container or 10% of the combined containers, whichever larger. If room has no floor drains, then the room itself may be considered sufficient secondary containment. If the room is considered the secondary containment ensure there is a lip at the door so no liquids can exit the room in the event of a leak. Verify field conditions before storing any chemicals

1. Provide temporary containment areas when permanent containment areas do not exist. Remove temporary containment at the end of construction.

1.6 WARRANTY

A. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion. This warranty does not include ongoing chemical treatment or monitoring.

1.7 ACCEPTABLE CHEMICAL SERVICE PROVIDERS (CSPS)

A. Approved CSPs

1. Rochester Midland: Paul Carroll, Water Treatment Specialist

PART 2 - PRODUCTS

2.1 GENERAL

A. CSP Services:

1. The CSP shall provide all cleaning and treatment chemicals, basic services, testing, equipment and materials necessary for a complete water treatment program.
2. The CSP shall perform an analysis of the supply water to determine the type and quantities of chemical treatment needed to maintain the required water quality to prevent corrosion, scaling, and biological growth.
3. Reports:

   a. Submit a written startup test report for each system placed into service.
   b. A service report shall be prepared on site by the CSP, submitted at the time of each service visit (with copies immediately provided to the Owner and Commissioner), which shall include all required test results and recommendations.
   c. Additionally, provide final reports for approval to the Owner and Commissioner regarding each site service visit, certified by an Officer of the CSP, within one week of any water treatment activity. Such reports shall include the results of any field or lab tests. Reports shall clearly state if the required water quality and maximum corrosion rates are being achieved.
   d. At a minimum, each report shall include the following information:

      1) System Treated:
      2) Date
      3) Conductivity
      4) pH
      5) Total Iron
      6) Total Copper
      7) Bacteria(cfu) (monthly analytical laboratory analysis)
      8) Coupon Corrosion Rates (three month analytical laboratory analysis)
      9) Make-up Water Quantity since Last Visit
      10) Corrosion Inhibitor level (ppm)
      11) Silica level (ppm)

4. Conduct final on-site system turn over meeting with Owner and Commissioner. Present final validation report demonstrating that performance requirements have been achieved and that each system is currently properly treated.

2.2 TREATMENT PROGRAM – FLUSHING AND CLEANING

A. Cleaning chemicals shall be non-phosphate and non-acidic.

B. Flush and clean all piping.

C. Provide a flush/clean plan for approval. Provide and later remove all temporary bypasses, drains, vents, etc. required to flush and clean the system. Temporary components for flushing and cleaning are not indicated on the drawings.

D. Flush and clean systems per the general procedures specified in Related Sections; clean systems per the approved cleaning procedures submitted under this specification section. Provide and install all required cleaning chemicals.

E. Verify that adequate cleaning chemical was added, that cleaning was effective, and test that cleaning chemicals were properly rinsed from the system. Provide a report certifying that cleaning and rinsing, was properly executed.

F. Provide passivation and chemical treatment immediately after each system has been cleaned and flushed. Systems shall not stand filled with fluids for periods longer than 48 hours without beginning flushing and cleaning which shall immediately be followed by the passivation and chemical treatment procedures.

2.3 TREATMENT PROGRAM – CHEMICAL TREATMENT AND PASSIVATION

A. Provide passivation and chemical treatment per the approved chemical treatment procedures. Chemically treat piping networks using chemicals and treatment procedures compatible with the system being cleaned.

B. Provide passivation/chemical treatment at system startup or immediately upon operation of a system for temporary cooling and heating, whichever comes first.

C. Provide chemical treatment immediately after each system has been cleaned and flushed. Thereafter immediately begin the approved water treatment maintenance program to passivate and prevent corrosion, scale, and organic growth and to maintain treatment chemical levels. Note that systems or parts of systems will not typically be started at the same time; adjust treatment strategy accordingly.

D. Provide chemicals that comply with State and Federal regulations.

E. Chemical inhibitor shall be polymer based and contain azole in an amount appropriate for the percentage of internal copper surface area of the system piping. Provide products with PTSA (p-Toluenesulfonic acid) florescent tracer dyes. Molybdenum shall not be used as a tracer. Optionally, for hot water heating systems only, nitrite/azole based inhibitors may be used.

F. No chemicals shall contain chromates or inorganic phosphates.

G. Utilize non-oxidizing biocides in the event sterilization is required.

H. Adjust chemical concentrations as required to achieve the required performance

2.4 PERFORMANCE REQUIREMENTS

A. The water treatment programs proposed by the CSP shall maintain corrosion rates below 0.5 mils per year for mild steel and 0.1 mils per year for copper. These rates shall be verified with corrosion coupons provided by the CSP Coupons shall be analyzed in the CSP's analytical laboratory every three months, more often if required, to assure these levels are not exceeded.

B. Microbiological growth levels shall be maintained below 10,000 cfu's aerobic bacteria and 10 cfu's anaerobic bacteria. The CSP shall perform detailed microbiological culturing at the CSP's company's analytical laboratory monthly, more often if required, to assure these levels are not exceeded

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Pre-Treatment Conference: Prior to treatment activities, meet with the Project Engineer, Commissioner and contractors to verify treatment procedures, discuss coordination with existing piping networks, and to coordinate treatment activities with construction schedule.

B. Flush and clean systems per Related Sections and Part 2 above.

3.2 INSTALLATION

A. Install all required components, and chemically passivate/treat and maintain the system as described in Part 2.

B. Use and dispose of chemicals and wastewater per the Quality Assurance section of this specification. All costs of disposal shall be borne by the contractor.

C. Provide and install all chemicals and all incidental components. Install equipment at locations shown on the Drawings. Follow the manufacturer's installation and startup instructions.

D. Passivate and chemically treat each system immediately after it has been cleaned and flushed.

E. The treatment program shall begin at system start-up or immediately upon first operation of the system by the contractor for temporary heating and cooling, whichever comes first. Continue the program until Substantial Completion.

3.3 FIELD QUALITY CONTROL

A. The CSP shall:

1. Verify that systems and equipment have been properly cleaned, flushed, and filled with water, and are fully operational before introducing operational chemicals for water-treatment systems.
2. Introduce and maintain chemical treatment to achieve the specified performance requirements.
3. Submit a written startup test report for each system placed into service.
4. Provide validation testing and required reports.
5. Attend final on-site system turn over meeting with Owner and Commissioner. Present final validation report demonstrating that performance requirements have been achieved and that each system is currently properly treated.

3.4 COMMISSIONING

A. Perform Commissioning activities per Related Sections above.

END OF SECTION 23 2513

SECTION 23 3100 – HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 20 0500: Common Work Results for Mechanical
2. Section 20 0548: Vibration Control
3. Section 20 0719: Mechanical Systems Insulation
4. Section 23 3300: Air Duct Accessories and RGDs
5. Division 26: Electrical.

1.2 SUMMARY

A. Section Includes:

1. Ductwork materials, plenums, construction, , fabrication, and support
2. Galvanized steel ductwork.
3. Stainless steel and aluminum ductwork.
4. Round ductwork.
5. Reinforcing and supports.
6. Flexible duct.
7. Flexible nonmetallic duct.
8. Duct sealants.
9. Duct cleaning and disinfecting
10. Ductwork sealing, inspection, and leakage testing.

1.3 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

C. ASTM A653 / A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, And Flat Bar.

E. ASTM B 209 & 209M – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

F. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.

G. SMACNA – All standards.

H. AWS - All applicable standards.

I. UL 181, 181A, & B – Factory-made Air Ducts and Connectors and Closure Systems.

J. Air Diffusion Council – Flexible Duct Performance and Installation Standards.

K. National Air Duct Cleaners Association (NADCA).

1.4 SUBMITTALS

A. Provide the following information and product data:

1. Project specific duct fabrication schedule including materials, methods of installation, and location of fitting types. Indicate the metal gauge and reinforcement method intended for each pressure classification and size of duct.
2. Hangers and supports
3. Duct fittings
4. Turning vanes
5. Duct sealant
6. Flexible duct

1.5 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide duct and fittings of G90 galvanized steel unless otherwise indicated.

B. Construct duct and fittings in compliance with SMACNA standards and recommendations and per the additional requirements indicated.

C. Duct dimensions indicated on drawings are inside dimensions. The sheet metal dimensions shall be increased an equivalent amount to accommodate internal liner where liner or double wall construction is required.

D. Drawings are diagrammatic and indicate the arrangement of the principal apparatus, ductwork, and piping, and shall be followed as closely as possible. All the required offsets, rises, drops, fittings and accessories are not indicated on the drawings, but shall be provided as required for a complete system. Carefully investigate structure, finish conditions, and the work of other sections affecting sheet metal work, including work associated with testing, adjusting and balancing, in order to arrange all items accordingly. Provide best possible arrangement to provide maximum headroom and maintenance clearances.

E. In addition to sheet metal ductwork specified herein, provide, or install as furnished by other sections, accessories and devices including, but not limited to, smoke detectors, plenums, canopy hoods, control dampers, and blank-off panels at unused louver areas.

F. Provide intake and exhaust plenums attached to louvers.

G. Alternate Joining Methods: As an alternate to SMACNA joining methods, Contractor may propose proprietary joining systems with performance equivalent to SMACNA for Owner's approval.

H. Refer to Drawings for ductwork construction and application schedule.

2.2 DUCTWORK MATERIALS AND FABRICATION

A. General Ductwork Fabrication Requirements:

1. Provide fittings, branches, inlets and outlets in such a manner that air turbulence is reduced to a minimum.
2. Turns:

    a. Use radius type elbows wherever possible. Where it is not possible to install a 1.5 times width to centerline radius elbow (full radius elbow), use lesser radii configurations, with 'radius-proportional' splitter vanes permanently installed within. No radius shall be less than 1.0 times width. Provide square elbows of equivalent pressure drop in rectangular ducts where radius elbows will not fit or where specifically noted on drawings. Elbows shall be installed with vanes in accordance with Related Section "Sheet Metal Accessories." Stamped elbows may be used up to and including a diameter of 12 in.

3. Transitions:

    a. Limit transition angles (for each side) to 15 degrees diverging and 30 degrees converging.

4. Take-Off Fittings:

    a. Provide flanged increased area branch take-off (45 degree entry, "shoe" type) or 45 degree lateral wye takeoffs. Conical fittings shall be used for spiral, round, and oval ductwork.
    b. For take-offs directly to side outlet for register or grille, provide an increased area tap. For take-offs directly to diffusers see appropriate SMACNA figures.
    c. Acceptable take-off fitting manufacturers:

        1) Sheet Metal Connectors, Inc.
        2) United Sheet Metal.
        3) McGill AirFlow LLC.
        4) Set Duct.
        5) Tangent.
        6) Flexmaster.
        7) SEMCO Incorporated.
        8) Sheet Metal Connectors, Inc.

5. Crossbreak or bead rectangular ductwork.
6. Rectangular duct longitudinal seams shall be Pittsburgh lock 3/8 in. minimum pocket.
7. Bolts and Fasteners

    a. Carbon steel, zinc coated per ASTM A153 for G-90 and stainless steel for aluminum and stainless steel ducts.

B. Galvanized Steel Ductwork:

1. Minimum steel rectangular duct gage shall be as follows:

    a. Ducts through 12 in. wide: 24 Gage
    b. Ducts 13 in. through 30 in. wide: 22 Gage.
    c. Ducts 31 in. through 84 in. wide: 20 Gage.
    d. Ducts 84 in. and larger: 18 Gage

2. ASTM A653, A924 mill galvanized steel sheet, 1.25 oz per sq. ft. zinc coating on each side in conformance with coating designation G-90.

C. Galvanized Touch-Up Paint: Inorganic zinc-rich touch up paint containing a minimum of 65 percent metallic zinc by weight for damaged galvanized coating.

1. Acceptable manufacturers/product: Carboline/Carbo-Zinc, Tnemec/Tneme-Zinc.

D. Stainless Steel Ductwork

1. Minimum stainless steel rectangular duct gauge shall be 18 gauge, for welding.
2. ASTM A167, type 304 .
3. Concealed stainless steel ductwork shall have an ASTM mill rolled No.1 or No.2 D finish.
4. Exposed stainless steel ductwork shall have an ASTM mill rolled No.2 B finish, or as indicated. Welds shall be ground smooth and final brushed with stainless steel wire brushes. Welds on exposed stainless steel ductwork shall be free of stain, burn-through, or discoloration.
5. Screws and rivets shall be stainless steel.

E. Round and Flat Oval Ductwork

1. All round and oval duct shall be manufactured of spiral lock seams, with minimum gage per the appropriate SMACNA Tables and per manufacturers recommendations. Ductwork up to 12 in. diameter and 2 in. w.g. can be manufactured with longitudinal lock seams.
2. Tees shall be conical. Laterals shall be straight. Taps through 10 in. diameter in size shall have a machine drawn entrance and fittings shall have longitudinal seams, continuously welded. Both sides of welds shall be primed with zinc chromate. Tap entrances shall be free of weld build-up.
3. Elbows in diameters 2 in. through 10 in. shall be stamped or pleated. Elbows shall be 5 gore for 90 degrees and 3 gore for 45 degrees. Elbows shall have 1.5 times width to centerline radius (full radius elbow).
4. Flanges, access doors and taps into spiral ducts shall be factory fabricated.
5. Field joints in diameters through 48 in. shall be made with 2 in. long slip-fit, sleeve coupling, or flanges. Ductwork 48 in. diameter and over, and for all sizes where disassembly or removal is required, shall be joined with flanges.

F. Reinforcing and Supports

1. Structural steel per ASTM A36; Mill galvanized per ASTM A653, Coating Designation G-90. Equivalent rolled steel structural support systems (such as TDF or TDC) may be used in lieu of mill rolled structural steel. Use double nuts and lock washers on threaded rod supports.
2. Tie-Rods

   a. Maximum tie rod spacing shall be 42 in., unless specifically engineered in accordance with SMACNA Industrial Rectangular Duct Standard.
   b. Minimum tie rod diameter shall be 1/2 in.
   c. Tie Rods shall not be used in any plenum or ducts that require access.
   d. Tie rods shall not be used in any PCD, stainless steel, or ducts carrying lint.
   e. Tie rods shall not be used in any return or exhaust ducts.

2.3 FLEXIBLE DUCT

A. General

1. Flexible duct shall be UL listed, and shall maintain shape when installed. Sagging shall not exceed 1/2 in. per linear foot when installed horizontally.
2. Flexible duct shall not be used where system pressure is greater than plus or minus 2 in. w.g.
3. Insulated flex shall have a fire retardant polyethylene outer jacket with an 8 oz. density, 1-1/3 in. thick fiberglass insulation blanket, factory wrapped.
4. Flexible duct used on negative pressure systems shall be specifically rated for negative pressure use.

B. Flexible Nonmetallic Duct

1. Flexible nonmetallic duct shall be constructed of sound transparent foil. Material shall be mechanically locked to the outside helix. Use of adhesives to lock fabric in place is not acceptable. The helix shall be constructed of corrosion resistant galvanized steel, formed and mechanically locked to the duct fabric on the outside to prevent tearing.
2. Flexible fabric duct shall be rated at 6 in. positive pressure and at 4 in. negative pressure.
3. Flexible nonmetallic duct shall be listed UL Class 1.
4. Acceptable manufacturers:

a. Flexmaster.
b. Hart & Cooley.
c. Atco.

2.4 SPECIAL DUCTWORK CONSTRUCTION

A. Ductwork required to be removable shall utilize companion flanges.

B. Ductwork systems serving areas of high process humidity shall be constructed of aluminum, min. thickness of 0.040 in., or 316L stainless steel. Ductwork shall be continuously welded and watertight.

1. Provide in the following areas, and where indicated:

a. Exhaust ductwork serving toilet room with shower to main branch or 10 foot length (whichever is longest).

2.5 DUCT SEALANTS

A. Solvent-based sealants may only be used if the outdoor air temperature will be below 40˚F within 24 hours of applying.

B. Sealant shall be non-asbestos type, and comply with UL and NFPA 90A.

C. Sealant: Water or solvent based elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) specifically for sealing ductwork. Use products as recommended by manufacturer for low, medium or high-pressure systems.

1. Manufacturers

a. Hardcast.
b. McGill Airflow LLC.
c. Polymer Adhesives.
d. Ductmate.

D. Tape shall not be used.

E. Gaskets and mastics used for flanged joints shall be compatible for the service of use and per the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL SHEET METAL INSTALLATION

A. Ductwork shall be installed to true alignment, parallel or perpendicular to adjacent building walls, floors and ceilings, to present a neat and workmanlike appearance.

B. Provide necessary offsets and transitions to avoid interference with the building construction, piping, or equipment. Locate ducts with sufficient space around equipment to allow operating and maintenance activities.

C. Bullhead tees are not acceptable.

D. Provide straight runs of ductwork, upstream and downstream, at equipment, fans, coils, and TAU's per manufacturer's recommendations and as indicated on drawings.

E. Provide flexible connector where ductwork connects to fans, air handling units and other rotating equipment and where indicated on drawings.

F. Repair damaged galvanized surfaces with zinc rich paint.

G. Enclose dampers located behind architectural intake or exhaust louvers in a sheet metal collar and seal to building construction.

H. Air volume control on parallel flow branches shall be accomplished with branch dampers; splitter type dampers are not acceptable.

I. Install special equipment items in ductwork systems including, but not limited to: control dampers, thermometers, airflow measuring devices and other related items, according to manufacturer's recommendations.

J. Store duct at least 4 in. above floor on wood pallets or similar devices. Protect duct from odors, dust, moisture, and other debris while stored on or off the jobsite, and when transporting to the jobsite, by tightly covering with plastic.

K. Ductwork openings shall remain protected and covered until just prior to connection. Immediately after assembly, restore all protection to prevent odors, dust, moisture, and other debris from entering ductwork system. Remove any internal labels.

L. Provide required penetrations and sleeves in building structure.

3.2 FLEXIBLE DUCT INSTALLATION

A. Flexible duct runs shall not exceed 5 ft. long. Cut to length so that it is not compressed. Trim ends squarely. Sag shall not exceed 1/2 in. per linear foot when installed horizontally.

B. Provide a minimum of 3 ft. of flexible non-metallic duct at connections to supply, return and exhaust diffusers/grilles, unless otherwise noted.

C. Support at a maximum spacing of 2 ft. using 4 in. wide sheet metal protection saddles at each duct hanger. Flex duct directional changes shall not exceed 45 deg with centerline radius of bend no less than one-half times duct diameter.

D. For connection to supply, return and exhaust diffusers/grilles located in horizontal ceilings, use pre-fabricated 90 degree plastic supports (such as the Flexflow Elbow by Thermaflex), or 90 degree sheet metal elbow fittings.

E. Apply duct sealant to outside surface of collars and secure with metallic draw-band where flexible duct joins other duct or devices.

F. Flexible duct shall not be used to connect terminal units to branch or main ducts.

3.3 DUCTWORK HANGERS AND SUPPORTS

A. Generally, hang and support ductwork per the latest edition of SMACNA. Additionally, adhere to the more specific requirements found in this specification section, the Related Sections, and as indicated on the project drawings.

B. Hanging duct, equipment, or accessories with cables or wires is prohibited.

C. Comply with Related Sections and drawing details regarding hangers, building attachments, fasteners, beam clamps and retaining clips, and as note below.

D. Provide vibration isolation as specified in Related Section.

E. Ductwork shall be supported and anchored to structure so that horizontal ducts are without sag or sway, vertical ducts without buckle and all ducts are free from deformation, collapse or vibration

F. Support un-insulated rectangular ducts in sizes to 36 in. by non-perforated galvanized steel strap or by trapeze hangers. Support insulated rectangular ducts and ducts larger than 36 in. with trapeze hangers.

G. Provide at least one support for each length of duct, with a maximum hanger spacing of 10 feet. Install supports on both ends of duct turns, branch fittings and transitions.

H. Do not hang ductwork from piping, ducts, other trades hangers, existing hangers, or equipment.

I. Single band hangers are not acceptable on ducts greater than 24 in. diameter.

J. Provide supports on each side of any duct mounted equipment or device, including fans, coils, dampers, etc, to permit removal of item without removal of adjacent duct sections.

K. Provide supplemental steel required to support ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned.

L. Beam clamps shall be double sided on ducts over 36 in. by 36 in. Use double sided or single sided beam clamps with retaining clips on all other sizes.

M. Provide clamping systems that are compatible with the structural steel system of the building.

N. Use angle iron "V" construction supports or similarly rigid construction for vertical ducting that requires lateral support.

O. Provide angle sway bracing and diagonal cross bracing to the structure to provide support against maximum lateral loads that may be imposed on the ductwork installed downstream of fan discharges and ductwork exposed to wind loads, and any other locations exposed to lateral loads.

3.4 DUCT PAINTING

A. Where the interior of duct is visible through grilles, registers, diffusers or other air diffusion devices, paint the interior flat black. Coordinate work with Architectural Trade.

B. For plenum returns, where equipment and structure above ceiling is visible through return air grilles, provide black sheet metal baffle with turned edges suspended from building construction. Size and position the baffle to prevent restriction of air flow. Where space above ceiling precludes use of a baffle, paint visible building surfaces flat black.

3.5 TEMPORARY USE

A. Develop a plan that assures ductwork is protected during temporary use. Obtain approval of the plan from the Owner's Representative.

B. Maintain the protection plan until just prior to Owner turn-over.

C. Successfully complete return/negative pressure duct leak testing prior to duct temporary use.

D. Temporary filters shall be provided in return or negative pressure duct to protect ductwork and building contents when any fans are operated during construction. Filters shall have an equal or better performance rating than the air handling unit pre-filters specified for permanent use, but not less than MERV 8, in order to prevent construction dirt infiltration into duct systems. Install filters over grilles, diffusers, and all duct openings. Provide filters over supply grilles, diffusers and duct openings if construction dust and debris will enter when operated for temporary service (e.g. air system cycles off during periods when construction continues). Seal around temporary filters to prevent filter bypass.

E. Continuously maintain all filters and replace when pressure drop exceeds 1 in. w.c., or at manufacturer's recommended change-out pressure drop, whichever is lower.

F. Remove temporary filters and associated materials, and clean any adhesive residue from finished surfaces, at completion of temporary use.

3.6 DUCTWORK SEALING, INSPECTING AND LEAKAGE TESTING

A. Seal, inspect and test prior to insulating or concealing ductwork. Leak test per procedures in the latest edition of SMACNA.

B. Seal ductwork to meet SMACNA Class A.

C. Perform measured leak testing on the following ductwork:

1. All duct rated for pressure greater than 2" w.c.
2. Maximum permissible leakage rate:

   a. SMACNA Leakage Class 3.

D. Duct Leakage Testing Procedures:

1. Prior to fabrication and installation, develop and submit for approval a ductwork testing plan, indicating locations of temporary caps, surface area of ductwork test sections, test pressure, leakage class and allowable leakage in cubic feet per minute.
2. Notify the Owner's Representative at least 2 days prior to each test.
3. Provide all blank-off plates, flanges, and safing required to isolate each section of duct to be tested.
4. Provide necessary testing apparatus.
5. For all ducts, pressurize ductwork to the specified pressure class and inspect ductwork for visual and audible leaks, and leaks perceptible to a hand 2 in. from duct. Reseal all perceptible leaks until acceptable to Owner's Representative.
6. After completing visual and audible inspection, conduct measured ductwork leakage tests at the specified pressure class for the duct. Reseal and retest as required until successfully achieving the specified leakage class.
7. Submit leakage test report for approval, using SMACNA or other approved form.

3.7 COMMISSIONING

A. Perform the commissioning activities as outlined in the Division 01 Section Commissioning and other requirements of the Contract Documents.

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units and Downstream of Terminal Units:

a. Pressure Class: Positive 2-inch wg.

2. Ducts Connected to Variable Air-Volume Air-Handling Units:

a. Pressure Class: Positive 4-inch wg.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units:

a. Pressure Class: Negative 2-inch wg.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class:

1) Negative 3-inch wg for ducts within 75 feet of return fan.
2) Negative 2-inch wg for ducts beyond 75 feet.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.

END OF SECTION 23 3100

SECTION 23 3300 – AIR DUCT ACCESSORIES AND RGD'S

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

B. Related Sections:

1. Section 23 3100: HVAC Ducts and Casings.
2. Section 23 0900: Mechanical Systems Controls.
3. Section 23 3600: Air Terminal Units.
4. Division 26: Electrical.

1.2 SUMMARY

A. Section Includes:

1. Sheet metal accessories as shown in the Contract Documents and required for a complete and operable air distribution system
2. Access doors in ductwork.
3. Duct test holes.
4. Duct air turning vanes.
5. Flexible connectors.
6. Balance dampers.
7. Backdraft dampers.
8. Registers, grilles and diffusers.

B. Section does not include automatic control dampers. See Related Section 230900 Mechanical Systems Controls.

1.3 SUBMITTALS

A. Product Data: Submit performance data, rated capacities, furnished specialties, sound-power ratings, and accessories for each type of product.

B. Damper manufacturer's installation instructions.

C. Product Data for each type of product.

D. Shop Drawings:

1. Indicate the location and rating of all dampers on shop drawings and submittals.

E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

C. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

D. SMACNA "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

1.5 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCESS DOORS IN DUCTWORK

A. Provide access doors in ductwork to permit access to the linkage side of automatic dampers, fire dampers, smoke damper, combination fire/smoke dampers, upstream side of coils, filters, humidifiers, airflow measuring stations, other equipment or devices requiring access or other locations as indicated on Drawings for cleaning, maintenance, or inspection purposes.

B. Hang access doors on heavy gauge continuous hinges and secure in the closed position by means of metal clinching type cam latches. Hinges shall move freely. Where space conditions preclude hinges, provide four heavy duty cam-lock type latches, in addition to a retainer chain.

C. Access doors shall be of double wall insulated construction of not less than 20 gauge sheet metal, neoprene gasketed around the entire perimeter. Insulation between the metal panels shall be of the same thickness as the duct or panel adjacent to the access doors. Doors shall match duct material type, and at a minimum, the pressure class of the duct system in which they are installed.

D. Minimum Size: 24 inches by 24 inches when permitted by duct size. For smaller ducts, provide largest size access door that can be accommodated by duct height or width.

E. Acceptable Manufacturers:

1. Air Balance, Inc.
2. Ruskin Company,
3. Ductmate Industries, Inc.
4. Nailor Industries, Inc.
5. American Warming & Ventilating.

2.2 DUCT TEST HOLES

A. A. Permanent, factory fabricated duct test holes, with air-tight flanged fittings and screw cap. Provide extended neck fittings to clear insulation. Acceptable manufacturer and model:

1. Ventlock Model 699 by Ventfabrics, Inc.

2.3 DUCT AIR TURNING VANES

A. Provide factory manufactured turning vanes in each elbow where inside radius is less than the width of the duct, and in all square elbows located in duct construction of greater than 2 inches w.g.

B. Turning vane assemblies shall be adequately supported and affixed to prevent rattling, breakaway, and shall not deform. Assemblies longer than 12 inches shall be double wall.

C. Turning vanes in negative pressure ductwork with pressure rating above 2 inches shall be installed in accordance with SMACNA Industrial Duct Construction Standard.

D. Turning vanes shall match the duct material construction.

E. In lieu of turning vanes, use long radius elbows when the elbow free area is less than one square foot.

F. Acceptable Manufacturers:

1. Aero Dyne.
2. Ductmate Industries, Inc.
3. Sheet Metal Connectors, Inc.
4. Duro-Dyne.
5. DynAir Inc.

2.4 FLEXIBLE CONNECTORS

A. Provide flexible connectors of 4-inch minimum fabric width.

B. Fabric for flexible duct connectors at equipment shall be a minimum of 22 oz. glass fabric, double coated with neoprene, fire retardant, flame-proofed, waterproof, airtight, and approved by UL and conforming to NFPA 90A. Flexible connectors susceptible to sweating shall be of the insulated type.

C. Flexible connectors shall be rated for the same pressure as duct or equipment.

D. Flexible connectors in laboratory and process exhaust systems shall be of the material and type suitable for that environment.

E. Acceptable Manufacturers:

1. Senior Flexonics Pathway, Inc.
2. McGill AirFlow LLC, An enterprise of United McGill Corporation.
3. Duro-Dyne.
4. Ventfabrics, Inc.

2.5 GENERAL DAMPER CONSTRUCTION REQUIREMENTS

A. Dampers shall be rated for the maximum close-off pressure at the installed location, but not less than the rating as indicated in the Damper Construction and Application Schedule.

B. Dampers installed in galvanized ductwork shall be all galvanized construction including blades, shafts, bearings, linkages, etc. or as indicated in other sections.

C. Dampers installed in stainless steel ductwork, shall be constructed of Type 304 or Type 316 stainless steel construction including blades, shafts, bearings, linkages, etc.

2.6 BALANCE DAMPERS

A. For pressure dependent systems, as a minimum, provide balance dampers at each branch duct, at each outlet or inlet, and as indicated for supply air, return air, and exhaust air duct systems.

B. For pressure independent systems, as a minimum, balance dampers shall be provided at each branch for each outlet downstream of each supply air Terminal Airflow Unit (TAU) and at each branch inlet upstream of each return air or exhaust air TAU box and as indicated.

C. Comply with SMACNA requirement and provide continuous rod and bearings on each end of shaft regardless of pressure class.

D. Use 3/8 inch continuous square rod and 18 gauge stiffened blade for duct sizes 18 inches wide by 18 inches high and smaller, or 12 inches diameter and smaller.

E. Use 1/2 inch continuous square rod and 16 gauge stiffened blade for single blade dampers in ducts 19 inches to 48 inches wide by a maximum of 10 inches high; and in 12-inch to 16-inch round ducts.

F. When multi-blade dampers are required, use a manufactured 16 gauge, stiffened, opposed blade damper in a 14 gauge hat channel steel frame with reinforced corners. All hardware shall be galvanized, except use brass trunnions and bronze, steel, or synthetic bearings.

G. Quadrant shall be locking type.

H. Quadrant end of damper rod shall be factory slotted to indicate blade position.

I. Provide galvanized or stainless steel sheet metal "hat section" on ducts with exterior insulation so that quadrant will be exposed. Provide tight sealing nylon brushing at duct opening for damper shaft under hat section.

J. Each square rod shall be installed so that quadrant will be accessible for adjusting.

K. Provide 24-inch-by-24-inch access door through ceiling or wall construction for each balance damper that is not accessible.

L. Acceptable Manufacturers:

1. Ruskin Company.
2. Young Regulator Company,
3. American Warming & Ventilating Co.
4. Vent Products Co., Inc.
5. Arrow United Industries.
6. Greenheck.

2.7 BACKDRAFT DAMPERS

A. Frames shall be flanged, a minimum of 3 inches wide, and a minimum of 20 gauge roll formed galvanized steel or 0.125 inch extruded aluminum with pre-punched mounting holes and welded corner clips for maximum rigidity.

B. Blades shall be a single piece, with a maximum width of 6 inches, counter-balanced, and shall be constructed of a minimum of 28 gauge roll formed galvanized steel or 0.070 inch extruded aluminum. Blade ends shall overlap for maximum weather protection.

C. Blade seals shall be extruded vinyl and mechanically attached to blade edge.

D. Bearings shall be corrosion resistant synthetic.

E. Linkages shall use a galvanized tie bar with stainless steel pivot pins.

F. Axles shall be stainless steel.

G. Mounting shall be suitable for the required orientation.

H. Acceptable Manufacturers:

1. Young Regulator Company.
2. American Warming & Ventilating Co.
3. Vent Products Co., Inc.
4. Arrow United Industries.

2.8 REGISTERS, GRILLES AND DIFFUSERS

A. General:

1. Diffusers, grilles, and registers shall be of steel or aluminum construction, factory primed and painted with baked enamel or acrylic, white color, unless otherwise scheduled.
2. Diffusers, registers and grilles shall be compatible with the designed ceiling/wall type. Provide registers and grilles with frames that are compatible with adjacent construction, with countersunk mounting holes. Refer to architectural drawings for exact details of ceiling/wall construction.
3. Engineering data shall be based upon tests conducted in accordance with the latest ASHRAE Standard 70, Method of Testing for Rating the Performance of Air Outlets and Inlets at non-isothermal conditions. Published Noise Criteria (NC) data shall be determined based upon a 10 dB room attenuation across all octave bands. Lab test reports shall be available upon request.
4. Refer to schedule on drawings for basis of design diffusers, registers and grilles.

B. Return and Exhaust diffuser:

1. Diffusers shall be square with neck sizes to match connecting duct size.
2. The diffusers shall be constructed with an integral leak-proof collar extending minimum 1 inch above the core to accommodate duct connection. Square and rectangular collars shall have welded corners.

C. Acceptable Manufacturers:

1. Tuttle & Bailey.
2. MetalAire.
3. Titus.
4. Price Industries.
5. Nailor Industries, Inc.

PART 3 - EXECUTION

3.1 SHEET METAL ACCESSORIES INSTALLATION

A. Install sheet metal accessories in accordance with manufacturers' recommendations, Contract Drawings and approved submittals.

B. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Refer to other related sections for installation requirements, including joint connections and sealant requirements.

D. Install duct accessories according to applicable details in SMACNA "HVAC Duct Construction Standards - Metal and Flexible."

E. Install duct accessories of materials suited to duct materials. Use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless steel ducts, use aluminum accessories in aluminum ducts.

3.2 DUCT ACCESS DOORS INSTALLATION

A. Locate access doors so they can be opened completely without interferences and to allow easy access by maintenance personnel.

B. Doors shall seal tightly into frame.

C. Label access doors to note equipment that is accessed through the door. Labels and lettering on labels shall be in accordance with the mechanical identification section. Provide 1-inch-high minimum letters.

3.3 DUCT AIR TURNING VANES INSTALLATION

A. Mount the outboard-most vane in the duct heel. Vanes shall be spaced across the entire corner diagonal, parallel to the airstream, adequately supported and affixed to prevent rattle and breakaway.

3.4 DUCT TEST HOLES INSTALLATION

A. Provide duct test holes where required for testing and balancing purposes and as shown on Drawings.

3.5 DAMPER- INSTALLATION - GENERAL (INCLUDING AUTOMATIC CONTROL DAMPERS FURNISHED UNDER RELATED SECTION)

A. Dampers shall be installed square and plumb to casing, duct, wall, etc. without racking. Align and adjust dampers to ensure proper opening and closing without binding or hesitation.

B. Seal completely around frame.

C. Install dampers designed for horizontal mounting in horizontal orientation, and dampers designed for vertical mounting in vertical orientation.

D. Adequately reinforce multiple section dampers per manufacturer's recommendations.

E. Install dampers so quadrants will be accessible for adjusting.

F. Coordinate access through ceilings or walls to ensure each damper is accessible.

G. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

H. Set dampers to fully open position before testing, adjusting, and balancing.

3.6 FLEXIBLE CONNECTORS INSTALLATION

A. Flex connectors shall be used in all ductwork that crosses building expansion joints and at attachment to any equipment mounted on vibration isolators, and inlets and outlets of fans.

B. The connectors shall be installed as close to equipment as practical and the clear gap at rest shall not be less than 3 inches.

C. There shall be no tension of the fabric under static or dynamic loads. Connector shall be free of wrinkles caused by misalignment or fan reaction. End and overlaps shall be sealed airtight.

D. Check connections during operation for leaks and binding.

3.7 REGISTERS, GRILLES AND DIFFUSERS INSTALLATION

A. Support devices independent of the ceiling construction when required for safe and workmanlike installation.

B. Paint visible duct, mounting clips, and accessories behind registers and grilles flat black.

C. Adjust throw patterns as shown on Drawings

D. Install security products as detailed on drawings

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers and operators to verify full range of movement.
2. Inspect locations of access doors and verify proper labeling and access to equipment.
3. Inspect turning vanes for proper and secure installation.

3.9 COMMISSIONING

A. Perform the commissioning activities as outlined in the Division 01 Section Commissioning and other requirements of the Contract Documents.

END OF SECTION 23 3300

SECTION 23 3400 - FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 01 9100/01 9110 “Commissioning”
2. Section 20 0513 “Motors”
3. Section 20 0548 “Vibration Control”
4. Section 23 3300 “Air Duct Accessories and RGDs”
5. Section 23 0593 “Testing, Adjusting, and Balancing”
6. Section 23 0900 “Mechanical Systems Controls”
7. Division 26 “Electrical”

1.2 SUMMARY

A. Section Includes:

1. Centrifugal Fans:

a. Inline fans

1) Square Inline Centrifugal

1.3 SUBMITTALS

A. Submit the following product data for each unit:

1. Static pressure, airflow (CFM), speed (RPM), system curve, outlet velocity and fan tag for each fan.
2. Certified fan curves showing fan performance with the system operating points identified on curves. Surge, or "Do not operate" line, shall also be indicated on fan curve.
3. Performance curves shall be published by the fan manufacturer and based on tests in accordance with AMCA 210. The curves shall be drawn with the fan flow rate plotted against fan total pressure and fan brake horsepower as per section 10.2.1 of AMCA 210.
4. Bearing sizing and life calculations for each similar size and type of fan. Fan bearing calculations shall be based on fan maximum operating conditions including belt pull. Calculations shall be provided for both fan bearings and motor bearings.
5. Sound power levels for each size and type of fan. Sound levels shall be provided for all 8 octave bands for discharge of fan, inlet to fan, and radiated noise through casing.
6. Dimensional data for each size and type of fan, including operating and maintenance clearances.
7. Details of vibration isolation bases including selections for vibration isolation springs.
8. Details of fan discharge flexible duct connector.
9. Details of motor and belt guards.
10. Motor ratings, electrical characteristics, and motor accessories.

1.4 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

1. ANSI/AMCA Standard 99-2404, "Drive Arrangements for Centrifugal Fans."
2. ANSI/AMCA Standard 99-2406, "Designation for Rotation and Discharge of Centrifugal Fans."
3. AMCA Standard 99-2408, "Operating Limits for Centrifugal Fans."
4. ANSI/AMCA Standard 210 ANSI/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."
5. ANSI/AMCA Standard 260 "Laboratory Methods of Testing Induced Flow Fans for Rating."
6. ANSI/AMCA Standard 300, "Reverberant Room Method for Sound Testing of Fans."
7. ANSI/AMCA Standard 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data."
8. ANSI/AMCA Standard 204, "Balance Quality and Vibration Levels for Fans."
9. American Bearing Manufacturers Association (ABMA) Standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Fan manufacturer shall provide protection to insure that the interior and exterior of each fan is completely protected from dirt or weather during shipping. Openings shall be covered with sealed sheet metal, plastic or other durable means to ensure unit cleanliness is maintained.

1.6 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. All fan types:

a. Loren Cook Company
b. Acme
c. Twin City
d. Aerovent
e. Greenheck
f. Trane
g. Barry Blower
h. Penn

2.2 GENERAL CONSTRUCTION- ALL FANS

A. Provide balanced variable sheaves for motors 7.5 HP and under and fixed sheaves for motors 10 HP and over. Size variable sheaves at midpoint of specified operating conditions to allow field adjustment up or down during balancing procedures. Where fixed speed sheaves are specified for a specific fan, provide one (1) additional sheave set, if required, for final balancing.

B. Fan selection and ratings shall be based on tests made in accordance with AMCA 210.

C. Fans shall be AMCA licensed and shall bear the AMCA seal for both sound and performance levels.

D. Fan shall be minimum Class I construction with proper UL label.

E. The specified fan RPM, outlet velocity, and tip speed are the maximum acceptable. The motor horsepower, CFM, and static pressure are the minimum acceptable.

F. Unless noted otherwise by specific fan type or per schedule, fan housing shall be heavy gauge continuous welded corrosion resistant steel construction with fan scroll and bearings supported from structural steel framework.

G. All fasteners shall be corrosion resistant type.

H. Fan housing shall be of suitable thickness and bracing required for stable and rigid construction, with no deflection, and to prevent vibration and pulsation.

I. Fans having duct-connected inlets shall be provided with a flanged inlet and/or outlet collar matching companion flange.

J. Provide OSHA belt guards on all belt driven fans.

K. Fans shall be spark-proof Type A, B or C (AMCA 99-0401) as required by application.

L. For exterior mounted fans, a weatherproof housing shall be provided with ventilation grilles to cover motor and drive assembly.

M. Provide special construction fans, such as spark-proof, explosion-proof, or specially coated fans as required by schedules or as specified herein.

N. Provide birdscreen on fans exposed to the exterior environment.

O. Provide adequate space for service of fan, motor and bearings.

P. The fan shaft shall be solid high carbon steel, accurately turned, ground and polished, and ring gauged for accuracy.

Q. Recommended bearing manufacturer tolerances shall be met in the area of the shaft in contact with the bearings.

R. Shafts must be dial indicator inspected for straightness after the keys are cut.

S. Fan shaft shall be coated with rust inhibitive coating.

T. Fan wheel assembly or propeller assembly shall be statically and dynamically balanced prior to fan assembly.

U. The entire rotating assembly shall be designed so the first critical speed is at least 25% over the maximum fan class speed.

V. Fan Shaft Bearings:

1. Fan bearings shall be bolted on a rigid welded steel framework integral with the housing.
2. Bearings shall be designed and individually tested specifically for use in air handling applications.
3. Bearings shall be sized for a minimum L-10 life of 200,000 hours at the maximum fan class operating speed and horse power. Selection shall account for all operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the American Bearing Manufacturers Association (ABMA).
4. Bearings shall be grease lubricated self-aligning ball or roller type. Provide tapered roller bearings for vertical applications.
5. Bearing housings shall be solid cast iron, pillow block or flange mount type. Provide split pillow block bearings where required by the application speed.
6. Stamped bearing housings are permitted on fans of 1/4 HP or less.
7. Bearings shall be of the type that can be re-lubricated, and shall be equipped with grease fittings.

W. Fan Drive:

1. Fan drive shall be a multiple V-belt type sized for 1.65 times the fan motor horsepower. Sheaves shall be fixed or adjustable based on fan motor horsepower as specified herein before. Fan sheave shall have a tapered lock, split and keyed hub. Groove spacing on equipment and motor pulleys shall align. For fans 1/2 HP and larger, quantity of belts shall be such that if any one belt fails, remaining belts shall allow fan to continue functioning as designed. Multiple belts shall be provided as a matched set.
2. Motors shall meet requirements as specified in Motors section.
3. Motor shall be 1800 rpm maximum nominal speed for belt driven fans.
4. On OSHA approved type fan drive guard shall be provided with provision for RPM measurement at both motor and fan without removing the guard. The guard shall be made of 1/2 in., 16 gauge flattened expanded steel, wrapped around a 16 gauge channel frame suitably braced to prevent vibration. Guard shall be G-90 galvanized, or painted to match fan housing paint.
5. Fan belts shall be oil resistant 24,000-hour non-static belts.

X. Provide riveted, engraved aluminum nameplate containing pertinent, specific fan data, including manufacturer, model, serial number, and electrical data, etc.

2.3 PAINTING

A. Each fan component shall be thoroughly cleaned, degreased and deburred.

B. Prior to assembly, prime coat all non-galvanized ferrous metal parts with zinc rich primer (minimum 70 percent zinc), total dry film thickness of not less than 1.3 mils.

C. For interior units, finish paint all non-galvanized ferrous metal parts with alkyd enamel paint.

1. Low-luster interior enamel; total dry film thickness of not less than 2.6 mils.

D. For exterior units, finish paint all non-galvanized ferrous metal parts with alkyd enamel paint.

1. Semi-gloss exterior enamel; total dry film thickness of not less than 2.6 mils.

E. Aluminum and stainless steel parts do not require painting.

2.4 CENTRIFUGAL FANS

A. General:

1. Centrifugal type fans shall be belt drive, unless noted otherwise
2. Fans shall be backwardly inclined, airfoil, or flat blade type with a minimum of 9 blades.
3. Fans shall have sharply rising pressure characteristics at the operating point specified and shall be quiet and stable in operation. Horsepower characteristics shall be self-limiting (non-overloading) and at peak value at the specified operating point.
4. Each fan base shall be fully assembled with motor and drive.

B. Centrifugal Inline Fans:

1. Square Inline Centrifugal:

a. Fan housing shall be of bolted and welded construction utilizing corrosion resistant fasteners. Housing shall include airflow straightening vanes and integral duct flanges. Adjustable motor plate shall utilize threaded studs for positive belt tensioning. Access doors and mounting feet shall be located as required for the specified position.

b. Construct fan wheel of 100 percent aluminum, including a precision-machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.

2.5 SOURCE QUALITY CONTROL

A. Run test all fans 1 HP and larger at the factory before shipment. Testing shall be conducted at the maximum fan class speed.

B. Statically and dynamically balance each fan per AMCA procedures. Perform electronic vibration analysis at the maximum fan class speed for all fans over 5 HP.

C. Unless noted otherwise, the installed maximum allowable RMS velocity at maximum fan class speed measured at each bearing shall not exceed 0.09 inches/sec in vertical, horizontal, and axial directions.

D. Fans may be field tested after installation by an independent third party. Any fan found to exceed specified vibration limits shall be corrected to perform within those limits without cost to the Owner.

PART 3 - INSTALLATION

3.1 FAN INSTALLATION

A. Coordinate the fan arrangement with project conditions prior to ordering the fan.

B. Receive and inspect fans for defects. All defective or damaged fans shall be replaced at no cost to the Owner.

C. Openings shall remain protected during storage. Immediately after installation and assembly, all factory protection shall be restored. Unit shall remain protected until just prior to final acceptance by Owner.

D. Use spreader bars on lifting cables when hoisting fans from lifting lugs to prevent cable damage to housing or components. Rig fans per fan manufacturer's recommendations.

E. Fans shall be installed as shown on drawings, in accordance with details, approved submittals and the fan Manufacturer's installation requirements and recommendations. Ensure fans are installed to allow easy accessibility for service or removal of fan components.

F. Provide and install supplemental steel, supports, isolators and hangers necessary to hang or mount fans. Coordinate final location and placement of intermediate steel and ductwork connections in field. Install suspended fans with supports attached to structural members.

G. Install any associated motors, drives, or other components that have been shipped loose. Fan shall be installed, made fully operation, and tested.

H. Install flexible inlet and discharge couplings to prevent vibration transmission to ductwork.

I. Inlet and discharge ductwork shall have a minimum straight run of two (2) fan diameters upstream and downstream of the fan.

J. Just prior to final acceptance fan shall be thoroughly cleaned of all grease, dirt, and dust, etc. Apply touch-up paint or touch-up coating after final cleaning to repair any damage to the finish.

K. Provide or coordinate the scope of work associated with the installation of fans as specified in the following sections:

1. Vibration isolation
2. Sheet Metal accessories
3. Interconnection wiring and conduit from power source to fan connection (starter).

L. Perform the following tests and inspections prior to fan operation:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices, and that connections to ducts and electrical components are complete.
3. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. Inspect fan scroll for debris or water.
6. Remove guards. Align and adjust belt tension, verify that fan wheel and motor rotate freely, and that bearing operation is smooth. Re-install belt guards.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication of bearings and other moving parts. Use proper bearing venting procedures, in particular at motor bearings. Use only grease type specifically recommended by fan mfr. Do not over-grease. Fill extended grease lines if not already filled, using mfr. recommended grease and proper venting procedures.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Verify proper motor and fan rotation.
11. Remove and replace malfunctioning units and retest as specified above.

M. Temporary Use of Fans

1. Contractor shall thoroughly clean unit of all grease, dirt, and dust, etc. and perform manufacturer's pre-start protocol and commissioning activities just prior to being placed into temporary service.
2. During temporary service, perform all of manufacturer's required routine maintenance procedures. Continuously maintain a log of all such procedures. Store log at unit during temporary use period and include log as part of the final O&M manual.
3. Contractor shall thoroughly clean unit of all grease, dirt, and dust, etc., lubricate bearings, align and tighten belts and perform manufacturer's pre-start protocol and commissioning activities after unit has completed temporary service, and install a new, complete set of filters just prior to final acceptance by Owner.

3.2 FIELD QUALITY CONTROL

A. Each fan shall be field tested. Any deficiencies related to performance, manufacture or installation shall be corrected without cost to Owner.

3.3 COMMISSIONING

A. Perform the commissioning activities as outlined in the Division 01 Section Commissioning and other requirements of the Contract Documents.

END OF SECTION 23 3400

SECTION 23 3600 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 23 0900: Mechanical Systems Controls
2. Division 26: Electrical.

1.2 SUMMARY

A. Section Includes:

1. Terminal airflow units (TAUs) of the various types, arrangements and sizes as specified in this Section and scheduled on Drawings.
2. Variable Volume (VAV) Terminal Airflow Units.
3. Fan powered air terminals.
4. Terminal Airflow Unit-Mounted Reheat Coils.
5. Airflow-sensing array(s) and dampers on TAUs to be equipped with DDC controls.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Controls Contractor shall coordinate with the terminal airflow unit manufacturer to provide a complete operating system.

1.4 SUBMITTALS

A. Product Data: Provide performance data, rated capacities, furnished specialties, sound-power ratings, and accessories for the following.

1. Terminal airflow units.
2. Liners and adhesives.
3. Sealants and gaskets.
4. Damper and casing leakage data.
5. Hangers and supports, including methods for duct and building attachment and vibration isolation.

B. Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.5 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

1. AHRI 880: "Performance Rating of Air Terminals." Test in an AHRI certified laboratory. Units shall be AHRI 880 sealed.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Insulation/liner:

   a. UL 723, "UL Standard for Safety Test for Surface Burning Characteristics of Building Materials."
   b. UL 181 "UL Standard for Safety Factory-Made Air Ducts and Connectors." Limited to mold growth and humidity test and erosion test.
   c. ASTM C1071 - 05e1 "Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)."
   d. ASTM E84-10 "Standard Test Method for Surface Burning Characteristics of Building Materials."
   e. NFPA 90a: "Standard for the Installation of Air-Conditioning and Ventilating Systems."
   f. NFPA 90b: "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems."

4. Coils: AHRI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils."
5. SMACNA "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
6. ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Mark each terminal unit before shipment to the job site with a unique identifier corresponding to its location and function in the building. Identifier nomenclature shall correspond to the Terminal Airflow Unit Detail.

1.7 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Terminal Airflow Unit Manufacturers:

   1. Titus.
   2. Carnes.

2.2 ACOUSTIC PERFORMANCE

A. Provide acoustic performance, including performance supplemented by sound attenuators, as scheduled on Drawings. Acoustical performance shall be met at all damper positions with 1 inch static pressure at the TAU inlet.

2.3 FIRE AND SMOKE TEST PERFORMANCE

A. Insulation: Maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for insulation and adhesive, when tested according to ASTM E 84.

2.4 SINGLE DUCT TERMINAL AIRFLOW UNIT (TAU) (VAV)

A. Provide single duct, variable or constant volume terminal units as scheduled and detailed. Electronic controllers shall have the minimum and maximum airflow rates preset at factory with capability of field adjustment.

B. Damper Assembly: Minimum 20 gauge construction with a mechanical stop to prevent over stroking.

C. Terminal unit: Mechanically assemble and seal to provide an airtight casing. Casing air leakage shall not exceed 10 cfm at 1 inch w.c. differential pressure.

D. Line interior walls of the terminal casing with 1/2 inch minimum, 4 lbs./cu.ft. dual density fiberglass acoustical/thermal insulation with a non-porous, aluminum foil reinforced face sheet covering of the acoustical/thermal liner. Rate liner covering for a maximum air velocity of 6,000 fpm. Wrap and seal exposed foil lining edges from the airstream, and tucked and secured with metal barriers.

E. Provide a position indicator on the damper shaft marked on the end to verify damper position.

F. Screw damper blade through the shaft to prevent slippage and include a closed cell foam gasket to ensure minimum leakage.

G. Damper air leakage shall not exceed 5 cfm at 3.0 inches w.c. differential pressure.

H. Provide damper pivot with a Celcon or Delrin bearing.

I. Equip the terminal unit with a multi-axis flow sensor with amplifying pressure pick-up points connected to a center averaging chamber. The chamber shall be designed to provide a differential pressure signal at least 1.5 times the normal unit velocity pressure over the full capacity range of the unit. Pressure sensing pick-ups shall be extended to the outside of the casing and have capped TEEs to permit parallel pressure measurements. A flow curve for field balancing shall be affixed to the terminal unit casing on the controller side. Minimum accuracy shall be 90 percent, regardless of inlet conditions.

J. Provide pneumatic tubing in accordance with the requirements of the Temperature Controls Section.

2.5 TERMINAL AIRFLOW UNIT CONTROLLER AND ACTUATOR

A. DDC Controls: Provide damper and flow sensor.

2.6 TERMINAL AIRFLOW UNIT-MOUNTED REHEAT COILS

A. Provide coils by the terminal airflow unit manufacturer as a complete factory-mounted assembly, with capacities and characteristics as scheduled on the Drawings. Provide slip and drive or flanged connections to allow removal and reversal of coils in field.

B. Coils: Maximum of 10 fins per inch, same side supply and return (steam/condensate) piping connections, enclosed in a sheet metal casing to match the size of the attached terminal airflow unit.

C. Water Coil: Minimum 2-row coils, rated for 200 psi working pressure, 250 deg. F, with 3/8 inch copper tubing, minimum wall thickness of 0.016 inch, and mechanically bonded aluminum fins, 1/2 inch or larger solder connectors, and manual air vent on return. Hydrostatically test coils at 250 psi, or at 250 psi air pressure under water. Maximum pressure drop at design flow shall not exceed 10 feet or as scheduled. Hot water shall be equally distributed through all tubes by means of orifices or a header design.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Review and examine conditions affecting work. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Commissioning: Review and perform required commissioning activities in the pre-construction phases.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with applicable SMACNA HVAC Duct Construction Standards and Hanger and Support construction standards, and applicable Division 23 Sections.

B. Support TAU's independently from adjacent ductwork. Ensure supports do not interfere with accessibility of other equipment, e.g., access to TAU DDC control enclosure. Do not hang TAUs from piping, other ducts or equipment.

3.3 TERMINAL AIRFLOW UNIT INSTALLATION

A. Install TAUs in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.

B. Provide a minimum of 2 duct diameters rigid straight duct upstream of terminal unit with a bell-mouth or shoe-tap to minimize pressure drops.

C. Label unit according to the applicable detail.

D. Position terminal air flow unit, unit-mounted controller, reheat coil, and sound attenuators to comply with clearance requirements and for ease of maintenance.

3.4 COMMISSIONING

A. Perform the commissioning activities as outlined in the Division 01 Section Commissioning and other requirements of the Contract Documents.

3.5 SYSTEM START-UP

A. After start-up and operation of the HVAC system, sensors and controllers shall be cleaned and "blown-out" before final calibration of airflows and controls.

3.6 ADJUSTING, CLEANING, PROTECTION

A. Protect open end of terminal boxes, flow sensors and controllers throughout the entire construction period, until Commissioning and Substantial Completion.

END OF SECTION 23 3600

SECTION 26 0500 – COMMON WORK RESULTS FOR ELECTRICAL

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 work of this Section.

B. This Section shall apply to all Division 26 Sections.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01 Sections.

1. Codes and standards
2. Quality assurance
3. Examination of drawings and premises
4. Substitutions
5. Alternates that apply to the electrical work
6. Permits, fees and inspections
7. Changes involving Electrical Work
8. Submittals
9. Project record documents
10. Operation and maintenance manuals and equipment
11. Delivery, storage and handling
12. Warranty
13. Description of electrical systems
14. Scope of work specified in Division 26
15. Related work specified in other Divisions
16. Systems provided by the Owner

B. Part II – Products:

1. This Section includes basic requirements for materials and installations for electrical work, including but not limited to:

   a. Concrete
   b. Access doors
   c. Sealing of openings
   d. Sleeves
   e. Expansion fittings

C. Part III – Execution:

1. This section includes basic requirements for installations for electrical work.

   a. Electrical demolition work
   b. Temporary services
   c. Cutting and patching
   d. Chases and recesses
   e. Excavation and backfill
   f. Equipment foundations and supports
   g. Coordination with other trades
   h. Assembly and connection of equipment
   i. Field quality control

1.3 CODES AND STANDARDS

A. The electrical characteristics, physical properties, design, performance characteristics, methods of construction, all material and the installation techniques, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ADA – Americans with Disabilities Act
2. AEIC – Association of Edison Illuminating Companies
3. ANSI - American National Standards Institute
4. ASTM - American Society for Testing Materials
5. BICSI - Building Industry Consulting Service International
6. FCC - Federal Communication Commission
7. ICEA - Insulated Cable Engineers Association
8. IEC – International Electrotechnical Commission
9. IEEE - Institute of Electrical and Electronics Engineers
10. MBC – Michigan Building Code
11. MIOSHA – Michigan Occupational Safety Hazard Association
12. NEC - National Electrical Code
13. NETA – International Electrical Testing Association
14. NEMA - National Electrical Manufacturer's Association
15. NFPA - National Fire Protection Association
16. OSHA – Occupational Safety and Health Act
17. UL - Underwriters Laboratories, Inc.

1.4 QUALITY ASSURANCE

A. Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.

1. The Electrical Drawings indicate the general design and extent of the electrical system. Comply with the Drawings as closely as actual construction of the building and the work of other Trades permit.

B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.

1. All equipment of the same or similar systems shall be by the same manufacturer.

C. Regulatory Requirements:

1. Ordinances, Codes and Standards: Perform all work in accordance with applicable Federal, State and local ordinances and regulations. Perform all work to comply with Codes and Standards identified in these specifications.

   a. Notify the Architect/Engineer before submitting his proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
   b. Barrier-Free Regulations: All materials and installations shall comply with the requirements of the State of Michigan Handicapped Barrier-Free Regulations and with the Americans with Disabilities Act (ADA).

D. Rules of Local Utility Companies:

1. Perform work in accordance with the rules of local utility companies. Before submitting the bid check with each utility supplying service to this Project. Determine from them all equipment and charges which they will require and include the cost in the bid.

E. Field Measurements:

1. Drawings are not intended to be scaled for roughing-in or to serve as shop drawings. Take all field measurements required for fitting the installation to the building.

F. Sequencing and Scheduling: Sequence and schedule work so as to avoid interference with the work of other Trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.5 EXAMINATION OF DRAWINGS AND PREMISES

A. Before submitting Bids, examine the site, architectural, mechanical and other trades' drawings and specifications.

1. Notify Architect/Engineer should any discrepancies occur between them and the electrical work.
2. No additional charges will be allowed because of failure to make this examination, or to include all materials and labor required for the Electrical Work specified in other trade's documents or required due to existing conditions.
3. Before submitting Bids, examine the premises to determine existing conditions for performing the Work. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
4. The Architectural Drawings take precedence in all matters pertaining to the building structure, Mechanical drawings in all matters pertaining to Mechanical trades and Electrical drawings in all matters pertaining to Electrical trades installation. However, where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer who shall determine the course of action to be taken.

1.6 SUBSTITUTIONS

A. Base Bid shall be in accordance with materials or products specified. Any exceptions to this shall be approved in writing by the Architect/Engineer ten (10) days or more prior to bidding.

1.7 ALTERNATES

A. Mandatory Alternates:

1. The Contractor shall refer to Alternates listed in Division 01 and Proposals and shall submit price quotations for the alternates that apply to the electrical work.

B. Voluntary Alternates:

1. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the Bid, but will not affect the awarding of the Contract.

1.8 PERMITS, FEES AND INSPECTIONS

A. Obtain all permits, licenses, inspections and test required. Upon completion of the Work, obtain and send certificates of inspections and approvals to the Architect/Engineer.

1. Pay all fees and expenses for permits, licenses, tests and inspections.
2. A copy of the final approved Certificate of Electrical Inspection shall be provided as a requirement prior to final payment.

1.9 CHANGES INVOLVING ELECTRICAL WORK

A. The design of the electrical systems is based on the mechanical and building equipment specified and scheduled on the Drawings.

1. Where equipment changes are made that involve additional electrical work (increased motor horsepower or increased unit full load amperes, requirements for a disconnect switch scheduled to be part of the equipment, requirements for a starter scheduled to be part of the equipment, additional wiring of equipment, etc.) the Mechanical or respective trades involved shall compensate the electrical trades for the cost of the additional work required.

1.10 SUBMITTALS

A. The following is in addition to the requirements for submittals in Division 01.

B. Material List: Submit a complete list of all materials, equipment, and their manufacturers, for approval by the Architect/Engineer within 15 days after award of contract and prior to submittal of shop drawings.

C. Provide equipment submittals in the form of letters of intent, product data catalog sheets or shop drawings as hereinafter specified for all materials provided on the project.

D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4” x 5” on the label or beside the title block on shop drawings to record the Contractor’s review and approval markings and the action taken.
2. Include the following information on the label for processing and recording action taken.

a. Project Name
b. Date
c. Name and address of Architect/Engineer
d. Name and address of Contractor
e. Name and address of Subcontractor
f. Name and address of Supplier
g. Name of Manufacturer
h. Number and title of appropriate Specification Section
i. Drawing number, identification mark, fixture type, panelboard number, specification section number, and detail references, or as noted on the electrical drawings.

E. Equipment submittals shall be reviewed by the Electrical Contractor for completeness and accuracy and prior to submitting to the Architect/Engineer for review. Submittals shall be dated and signed by the Electrical Contractor. Note on the submittal any and all exceptions or changes to the drawings and specifications required by the submittal to meet the specified products.

F. Partial submittals for equipment shall not be permitted. Where partial submittals are transmitted to the Architect/Engineer, they will be returned "Rejected”.

G. Where the equipment submittals consist of manufacturer's standard detail drawing or schedules and contain data for a variety of similar equipment, indicate the data pertinent to the equipment furnished for this project only. Standard detail drawings and schedules not clearly indicating which data is associated with this Project shall be returned "Rejected".

H. Where accessories and/or options are specified and do not appear as part of manufacturer's standard detail drawings, state each accessory that is to be provided with the equipment on the standard detail drawings.

I. Letter of Intent shall state that the product is exactly as specified with no exceptions, and that the product is being manufactured by one of the specified manufacturers. The Letter of Intent shall include the specification section number, the product description, the name of the selected manufacturer and the catalog number of the product. The aforementioned information shall be typed on the Electrical Contractor's letterhead and submitted with one (1) product data sheet for each product itemized in the Letter of Intent for record.

J. Lighting fixture submittals shall be submitted as one (1) package including all fixtures intended to be used for this Project.

K. As part of the lighting fixture submittal the emergency lighting fixtures shall be submitted and include the following:

1. Catalog cut sheets for the emergency lighting fixture specified.
2. Catalog cut sheets for the lamps specified including horizontal and vertical isofootcandle distribution curves with lamp lumen information.

L. As part of the lighting fixture submittals, the following shall be submitted at the completion of the lighting system installation:

1. Provide field verification of the installation's emergency lighting levels in accordance with the requirements of the State of Michigan Consumer and Industry Services Office of Fire Safety policy number 2-19, referencing Section 5-9.2.1 of NFPA 101 Life Safety Code, 1997 edition.
2. Field verification shall be made by obtaining actual light level measurements using a light meter in a grid pattern at floor level with measurements points a maximum of 10 foot on center. Measurements shall be taken at night in order to obtain accurate readings. Required power equipment shutdowns shall occur in order to simulate power loss and properly operate the emergency lighting equipment.
3. Contractor shall submit floor plans denoting the actual field measurements as taken. Additionally, the contractor shall submit a letter on company letterhead indicating the specific dates and times of all field measurements, names of personnel performing measurements, make and model of light meter used, and date of last calibration of the light meter. The letter shall also indicate the following specific light readings:

    a. Maximum light level
    b. Minimum light level
    c. Average light level
    d. Maximum to minimum ratio.

M. CADD files of the electrical drawings will be provided by the Architect/Engineer for this Contractor's use in preparing lighting calculations, layout shop drawings and final record drawings. Refer to Division 01 for the forms and procedures for requesting electronic files/media.

N. Shop Drawings: Prepare layout shop drawings drawn to scale in electronic format and submit to the Architect/Engineer for review. After the shop drawings are reviewed, the submittal will be stamped and returned. Refer to Division 01 for submittals and quantities.

1. Layout shop drawings shall show building floor plans to scale and shall include lighting and power distribution systems, all details of electrical construction, routing of conduits, wiring, circuiting and related information necessary for the installation and future maintenance of the electrical wiring systems.

O. No apparatus or equipment shall be shipped from stock or fabricated until equipment submittals for them have been reviewed and approved by the Architect/Engineer. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Electrical Trades of full responsibility for the proper and correct execution of the work required.

P. Submittals shall be provided on all major electrical systems and/or equipment, including the following:

REMARKS LEGEND
Provide the following as indicated:

1. Factory Test Report
2. Field Testing Report
3. Record Drawings
4. Mock-Up
5. Material & Equip. List/Certificate
6. Operation & Maintenance Manuals
7. Construction Schedule
8. Points List
9. Sequence of Operation
10. Certificate of Inspection
11. Installer Certificate & Master Label
12. Fire Marshal Approval
13. Tools/Spare Parts
14. _____

Section Number	Section Title	Shop Dwgs.	Product Data	Letter of Intent	Samples	Warranty	Remarks
26 0500	Common Work Results for Electrical					X	6, 7, 10
	Layout Shop Drawings	X					3, 5, 13
	Materials List			X			5
26 0519	Low Voltage Electrical Power Conductors and Cables (0-600V)						
	Cable			X			1
	Splicing Connectors			X			
	Termination Lugs			X			
26 0526	Grounding and Bonding for Electrical Systems						
	Grounding Cable			X			
	Grounding Connections/fittings			X			
26 0529	Hangers and Supports for Electrical		X				
26 0533	Raceways and Boxes for Electrical Systems						
	EMT Conduit and Fittings			X			
	Flexible Steel Conduit and Fittings			X			
	Liquid-Tite Flexible Steel Conduit and Fittings			X			
	PVC Conduit and Fittings			X			
	Outlet Boxes			X			
	Pull Boxes			X			
	Floor Boxes and Fittings		X				
	Wireways		X				
26 0553	Identification for Electrical Systems						
	Electrical Identification Product		X		X		
	Schedule of Nomenclature			X			
26 0923	Lighting Control Devices		X				
26 0943	Locally Networked Lighting Control		X				

Section Number	Section Title	Shop Dwgs.	Product Data	Letter of Intent	Samples	Warranty	Remarks
26 2726	Wiring Devices						
	Wall Switches		X				2
	Receptacles		X				2
	Device Plates		X				
26 5100	Lighting Systems		X				
28 3111	Fire Alarm System - Direct Connected	X	X				6,10,12

1.11 PROJECT RECORD DOCUMENTS

A. Project Record Documents: Revise layout shop drawings as required during construction to indicate the as-built condition.

1. At the completion of the Project, resubmit to the Owner's Representative the revised set of “redlined” bluelines, (or electronic files with all changes from the bid documents bubbled) and one set of prints indicating “as-built” conditions for Owner's record. The Drawings shall contain all title block information as originally issued by the Architect/Engineer with the addition of the electrical contractor’s company name, address, telephone number, company’s project number, date of issuance by the electrical contractor, and issued for “Final Issue” conditions in title.
2. Furnish and deliver to the Owner’s Representative a manual of all shop drawings and product data upon substantial completion. The manual shall consist of a standard hard cardboard, vinyl covered, 3-ring binder, letterhead size, 8-1/2” x 11”. Shop drawings shall be folded and punched. All items and pages shall be numbered with typewritten index inserted at front of manual.
3. Submit final project record documents as described in Division 1.

1.12 OPERATION AND MAINTENANCE MANUALS AND EQUIPMENT

A. Operation and Maintenance Manuals: The manuals shall contain operating instructions, service instructions, parts lists, etc., which are shipped with electrical equipment. On completion of the work, transmit these items to the Architect/Engineer, for the Owner's use. If this information is not shipped with the equipment, obtain from the manufacturer.

B. Maintenance Materials: Retain all portable and detachable portions of the installation such as keys, tools, manuals, etc., until the completion of the work and then transmit them to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

C. Furnish three (3) sets of bound operation and maintenance manuals to the Architect/Engineer. Each set shall include:

1. One (1) copy of all shop drawings and product data
2. One (1) copy of operation and maintenance instructions and manuals
3. One (1) copy of all electrical testing results
4. One (1) copy of as-built drawings

1.13 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection: Provide adequate storage space for all electrical equipment, conduit and materials delivered to the job site under a weather protected enclosure. Location of the space will be designated by the Owner’s Field Representative. Equipment set in place in unprotected areas must be provided with temporary protection.

1. Be responsible for the care and protection of electrical equipment until it has been fully tested and accepted.

2. Protect materials with permanent factory finish from damage by covering.
3. Protect conduit openings with temporary plugs or caps.

1.14 WARRANTY

A. Warranty: Provide a one year parts and labor warranty for all equipment and installation. Comply with requirements of the General Conditions.

1.15 DESCRIPTION OF ELECTRICAL SYSTEMS

A. Type of Electrical Utility Service Contract: Primary Service Rate.

B. Utility Primary Voltage to Site: 13.2 KV, 3 phase, 3 wire, 60 hertz, neutral solidly grounded at the source.

C. Utility Electrical Secondary Service Voltage (Customer Service Entrance): 480/277 volt, 3 phase, 4 wire, 60 hertz, neutral solidly grounded at the source.

D. Power Systems: 480/277 volts, 3 phase, 4 wire, 60 hertz, neutral solidly grounded at the source.

E. Lighting Systems: 480/277 volts, 3 phase, 4 wire, 60 hertz, solidly grounded neutral.

F. Small Power System: 208/120 volts, 3 phase, 4 wire, 60 hertz, solidly grounded neutral.

G. Emergency Power and Emergency Lighting Systems: 480/277 volt, 3 phase, 4 wire, neutral solidly grounded.

1.16 SCOPE OF WORK SPECIFIED IN DIVISION 26 SECTIONS

A. Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections.

B. Provide control wiring greater than 100 volts for temperature, pressure, level and control devices, solenoid valves, control relays, and MCC control wiring, and all power wiring, required for equipment specified hereinafter.

C. The principal items of electrical work to be furnished and installed shall include but not necessarily be limited to the following items:

1. Demolition work as indicated on the drawings and as required to accommodate the network.
2. Modification of an existing 480/277 volt, 3 phase, 4 wire lighting distribution system, including branch circuit wiring and all connections complete to accommodate new lighting system.
3. A complete lighting system including fixtures, branch circuit wiring, controls, etc.
4. An exit lighting system connected to the emergency power system.
5. Modification of an existing emergency lighting system (egress lighting) consisting of selected general area lighting fixtures connected to the emergency power system.
6. Modification of an existing 208/120 volt, 3 phase, 4 wire power system for receptacle service. System shall include branch circuit wiring and all connections complete.
7. Underfloor conduit and branch circuits for 120 volt receptacles and telephone/data systems including presets, activation kits, boxes, devices and wiring.
8. Branch circuit wiring to all building wiring devices, including switches, receptacles, lighting fixtures, occupancy sensors and equipment.
9. An empty raceway system for telephone, video and data wiring consisting of boxes, conduit, pull wires, cover plates, cable tray, underfloor duct, backboard, etc.
10. Modification of an existing building fire alarm system including conduit, wiring, initiating devices, indicating devices and testing complete.
11. A local lighting control system consisting of lighting control relays, occupancy sensors, including all conduit wiring, boxes, and connections complete.
12. All items incidental to and/or required to complete the installation.

1.17 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Excavating, trenching, and backfilling for electrical – Division 31, except as specified in Division 26.

B. Furnishing and mounting of all electric motors – Divisions 14, 21, 22 and 23.

C. Furnishing and wiring of all new voltage thermostats – Division 23 sections.

D. Furnishing and installing field prime and finish painting – Division 09, except as specified in Division 26.

1.18 SYSTEMS PROVIDED BY OWNER

A. Furniture final connections to the furniture by this contractor.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

A. Furnish access doors as required to make accessible all controls, motors, electrical boxes and other equipment installed by Electrical trades or as required by Code.

1. Architectural trades will install the access doors provided under this Section.
2. Access door size shall be minimum 12” x 12” in walls, 24” x 24” in ceilings.
3. Plaster or acoustical tile inserts shall be by Architectural trades.
4. Equip access doors with screwdriver operated cam lock.

   a. Recessed panel access doors shall be designed to receive plaster or acoustical tile inserts. Furnish a plastic grommet and sleeve at the lock location.

5. Access doors in fire rated walls or ceilings shall be 1-1/2 hour rated, “B” label, 250 degF maximum temperature rise in 30 minutes, self-closing and self-latching and shall carry Underwriters Laboratories, Inc. (UL) or Warnock-Hersey Label.

B. In non-fire rated gypsum board, veneer plaster, masonry or ceramic tile walls, furnish “Type M, 3202 Series” access doors as manufactured by Milcor Ltd. Partnership or approved equal.

C. In non-fire rated gypsum board or veneer plaster walls and ceilings, furnish “Type DW, 3203 Series” by Milcor Ltd. Partnership or approved equal.

D. In fire-rated gypsum board, veneer plaster, masonry or ceramic tile walls, furnish “3208 Series” by Milcor Ltd. Partnership or approved equal.

E. In non-fire rated gypsum board, veneer plaster or plaster ceilings, furnish “Type M, 3202 Series” by Milcor Ltd. Partnership or approved equal.

F. In non-fire rated plaster walls or ceilings, furnish “Type K, 3200 Series” by Milcor Ltd. Partnership or approved equal.

G. In non-fire rated plaster or acoustical tile ceilings, furnish “Type AP, 3206 Series” and “Type AT 3205 Series” by Milcor Ltd. Partnership or approved equal.

2.2 SEALING OF OPENINGS

A. Seal openings around electrical materials (Conduit, raceways, cable trays, panels, etc.) where floors, fire rated walls and smoke barriers are penetrated. (Fiberglass is not acceptable.) Fire and/or smoke barriers shall be UL Listed fire and smoke stop fittings and shall have fire rating equal to or greater than the penetrated barrier. Refer to Section 078413 “Through Penetration Firestop Systems”.

2.3 SLEEVES

A. Provide conduit sleeves where conduits pass through concrete floors, walls, beams and ceilings.

B. Sleeves shall be galvanized rigid steel conduit. Do not use aluminum conduit. Where specific sizes are not indicated on the Drawings, sleeves shall be sized to provide one-half (1/2) inch clearance around the outside surface of the item for which they were installed. They shall be cut flush with wall surfaces, and shall extend one inch, or as directed through floor. Sleeves shall be packed with approved non-combustible packing material and sealed with sealant to prevent passage of air, liquid or fumes from one area to another. The filler and sealant materials used shall be rated at least equal in fire resistance to the construction material being penetrated. Floor sleeves shall be sealed between floor and sleeve with concrete grout.

2.4 EXPANSION FITTINGS

A. Provide expansion fittings in all conduits, cable trays, and feeder bus duct runs that cross building expansion joints, both in concrete slabs and where exposed.

PART 3 - EXECUTION

3.1 ELECTRICAL DEMOLITION WORK

A. General: Perform electrical demolition work in a systematic manner. Use such methods as outlined below to complete Work indicated on the Drawings.

B. Obtain approval from the Owner prior to interrupting existing services. All service interruptions shall be at a time suitable to the Owner. Where the Owner approves service interruptions at times resulting in premium time work to this Contractor, this Contractor shall include the premium time in his Base Bid.

C. The associated conduit, wire, junction boxes, supports, etc., of equipment indicated to be demolished shall be removed from the utilization equipment back to the source panel and the associated circuit breaker or fused switch shall be relabeled as “spare”, unless otherwise noted. All associated wiring shall be removed back to the “sources” as noted below:

1. Power: Remove conduit and wire back to the panel or power source.

   a. When the circuit originates from the panel and serves no other loads, remove conduit and wire back to the panel.
   b. When the circuit originates from a panel but continues on to other loads not intended to be removed, remove conduit and wire back to first junction box.
   c. When the removal of the circuit to the equipment to be demolished affects “downstream” devices not indicated to be demolished, re-feed “downstream” devices.

2. Fire alarm wiring: Remove as indicated on the drawings. Fire alarm system shall remain operational during building occupied hours in all tenant occupied spaces.
3. Data system wiring, telephone wiring or other special wirings: Remove wiring back to communication room or other source.
4. Conduit in walls to remain: Abandon in place. Install blank coverplates.
5. Conduit accessible above ceilings and/or other location: Remove conduit.

D. Perform a circuit trace prior to deactivating feeders and branch circuits to insure maintaining electrical power in adjacent unrenovated area.

E. Conduit in floor slabs being demolished shall be cut 1/2 inch below the floor and patched.

F. Where applicable, existing in-place conduit may be reused for new work providing that the installation is in accordance requirements for new work found in Division 26.

G. Where equipment or fixtures are removed, outlets shall be properly blanked-off, and conduits capped. After alterations are completed, the entire installation shall present a “finished” look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.

H. Materials salvaged from this work shall not be reused except where reuse is specifically indicated.

I. Existing fixtures and electrical equipment removed, not reused and not specifically indicated to be turned over to the Owner, shall be legally and properly disposed of off Owner’s property.

J. Existing fixtures and electrical equipment specifically indicated to be turned over to the Owner shall be disconnected, removed and turned over to the Owner in an undamaged condition to an on sight storage area as directed by the Owner.

3.2 TEMPORARY SERVICES

A. Provide temporary lighting, power and telephone service as described in Division 01.

B. The existing building will be occupied during construction. Maintain electrical services and provide necessary temporary connections and their removal at no additional expense. The Electrical Contractor shall be responsible for installing and maintaining a temporary service as required. Correlate routing of temporary service so as not to interfere with the convenience of the Owner.

3.3 CUTTING AND PATCHING

A. Refer to Division 01 for requirements for cutting, patching and refinishing work necessary for the installation of Electrical Work.

B. Direct miscellaneous cutting and patching of the existing building construction for the installation of the Electrical Work.

C. The cutting of holes through the existing building construction shall only be done by the use of abrasive saws and rotary coring machines. The use or hammer and drill points will not be permitted. The openings shall not be cut larger than necessary for the installation of the electrical work. Openings shall then be grouted in. Where existing piping, etc. is removed, the unused openings shall be grouted in.

D. The drilling or punching of structural members, such as holes through beams or columns, shall not be done without the specific permission of the Architect/Engineer.

E. Cutting of holes through floors and walls shall be done only at such locations as may be directed by the Architect/Engineer.

F. Cooperate with the other Contractors so that all cutting and repairing in any given area will be done simultaneously.

G. Electrical work which may interfere with changes in piping, ducts or other mechanical equipment, as well as conduits and outlets that may be uncovered by the cutting of new openings in present building shall be removed at the direction of the Architect/Engineer.

3.4 CHASES AND RECESSES

A. Provide sizes and locations of chases and recesses affecting the electrical work for provision by general trades.

3.5 COORDINATION WITH OTHER TRADES

A. Install Work so as to avoid interferences with the Work of other trades. Be responsible for removing and relocating any work which, in the opinion of the Owner's Representative, causes interferences.

B. Should construction conditions prevent the installation of switches, conduit, outlet boxes, junction boxes, conductors, lighting fixtures and/or other related equipment at locations shown on the drawings, minor deviations may be permitted and shall be as directed by the Architect/Engineer, and shall be made without additional cost to Owner.

C. The Electrical Trades will be responsible for all damage to other Work caused by their Work or through the neglect of their workers.

1. All patching and repairing of any such damaged Work shall be performed by the trades which installed the Work, but the cost shall be paid by the Electrical Trades.

3.6 ASSEMBLY AND CONNECTION OF EQUIPMENT

A. Assembly of Equipment:

1. The Contract Drawings and Specifications indicate items to be purchased and installed which are noted by a manufacturer's name, catalog number and/or brief description.
2. The catalog number may not designate all the accessory parts and appurtenances required for the particular use or function.
3. Arrange with the manufacturer for the purchase of all items required for the complete installation and efficient operation.

B. Equipment Connections:

1. Connections to equipment, motors, elevator controllers, lighting fixtures, etc., shall be made in accordance with the shop drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
2. Any and all additional connections not shown on the Drawings but called for by the equipment manufacturer's shop drawings or required for the successful operation of the particular equipment furnished shall be installed as part of this Contract at no additional charge to the Owner.

3.7 FIELD QUALITY CONTROL

A. Testing Ducts and Conduits: Ducts and conduits which are installed underground or concealed in concrete floor slab, foundations, etc., shall be cleared of foreign material and obstructions after installation and before conductor or pullwires are draw-in, by wire brushing, swabbing and employing an iron or hardwood mandrel which is 1/4" smaller in diameter than the internal diameter of the duct or conduit. Pulling wires shall be left in empty conduits.

B. Tests and Inspection:

1. When the systems are completed, operate equipment as directed by Architect/Engineer. Replace all faulty equipment. Make necessary adjustments before final acceptance.
2. Tests shall include but not be limited to panels, lighting fixtures, receptacles, fire alarm system, generator, transfer switch, sound systems, emergency lighting, branch circuits, etc.
3. Perform all tests required by State, City, County and/or other agencies having jurisdiction.
4. Provide all materials, equipment, etc., and labor required for tests.
5. Perform cable and equipment testing as specified.

C. Cleaning:

1. Keep premises free from accumulation of waste materials and rubbish. At completion of work remove all rubbish from and about the building and leave the electrical systems clean and ready for use.
2. Final clean-up shall include washing of fixture lenses, switchboards, substations, transformers, motor control centers, distribution panels, lighting panels, etc., to remove shipping and/or construction dust and debris. Fixture reflectors and/or lenses with water marks or cleaning streaks will not be accepted.

D. Painting:

1. In general, no painting is required by Electrical Trades other than touch-up of factory-finished electrical equipment.
2. All factory finished electrical equipment shall be cleaned at completion of the job. Equipment showing rust or mars shall be thoroughly cleaned and sanded, prime coated and touched up with enamel of color to match original finish.

E. Laying Out Exterior Work:

1. All exterior manholes, handholes, utility poles, lighting poles, bollards and similar equipment shall be staked by this contractor and approved by the engineer prior to installation.

END OF SECTION 26 0500

SECTION 26 0519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (0-600V)

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 work of this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conductors and cabling for buildings and structures electrical systems under 600 volts.
2. Wire and cable systems as required, and all material and equipment, including wire, cable, connectors, lugs, fittings, and identification, as indicated or specified.

B. Related Sections including the following:

1. Wiring for communications is specified in Division 27 and wiring for electronic safety and security is specified in Division 28.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

1. Conductors - Each type and size of wire and cable. Identify material, construction data, insulation thickness, and jacket thickness.
2. Connectors
3. Lugs
4. Labels
5. Insulating tape
6. Submit color coding schemes for branch circuit wiring.
7. Submit cable identifications.

B. Samples: Submit samples on request of the Architect-Engineer.

C. Submit test data for wire and cable upon request of the Architect-Engineer. Do not install wire and cable for which test data has been requested until test data is approved.

1.4 QUALITY ASSURANCE

A. Wire, Cable and Components: Listed by Underwriters' Laboratories as meeting National Electrical Code and NFPA 70 requirements and be so labeled.

B. Furnish wire and cable on which standard factory tests established by AEIC, ANSI, ASTM, ICEA and NEMA have been performed.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver all wire and cable to the site on reels or in coils, plainly marked for complete identification, including the wire or cable size, the number of conductors, type of wire or cable, length, weight, thickness and character of the insulation and the name of the manufacturer.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. General Requirements: Furnish wire and cable per standard specifications established for such material and construction by ASTM, ANSI, IPCEA and NEMA, where applicable. All conductors shall be copper unless otherwise specified. Minimum size of conductors shall be No. 12 AWG, except 120 volt control conductors which may be No. 14 AWG and 90 volt and less shall be as specified. Furnish conductor sizes as indicated. Conductors shall be stranded for sizes No. 14 AWG and larger. Conductors smaller than #14 AWG shall be as specified in the sections requiring use of such conductors.

1. Manufacturer: Provide products of one of the following:

a. Cerro Wire
b. Encore
c. General Cable Corporation
d. Prysmian
e. Republic Wire
f. Southwire
g. United Copper Industries

B. Wire for Use in Lighting Fixture Wiring Channels: Stranded copper, NEC Type RHH, THHN, or XHHW, rated 90 degC, 600 volts.

C. Wire for Exposed Cord Connection to Lighting Fixtures: Three conductor stranded copper, NEC Type SO rated 60 degC, 600 volts.

D. Wire for General Interior and Exterior Use: Single conductor, annealed copper, NEC Type XHHW, THHN and THHW rated 90°degC or THHN/THWN rated 90 degC in dry locations and 75 degC in wet locations, or NEC Type THW, THWN and XHHW rated 75 degC, all with 600 volt insulation.

E. Cable types MC, MI, NM, NMC or NMS shall not be used unless specifically noted on the drawings or in the specifications.

2.2 CONNECTORS FOR SPLICING COPPER CONDUCTORS

A. Connectors for Straight Splicing (Butt Splice) Conductors Up To and Including No. 8 AWG: Uninsulated solderless compression type.

1. Manufacturer: Provide one of the following:

a. Burndy "Hylink" Type YSVXX
b. Panduit
c. Thomas & Betts "Sta-Kon"

B. Connectors for Straight Splicing Conductors No. 6 AWG and Larger: Uninsulated solderless compression 2-way type.

1. Manufacturer: Provide one of the following:

a. Burndy “Hylink” Type YSXX-T
b. Thomas & Betts 54500 Series

C. Connectors for Pigtail Splicing Conductors Up To and Including No. 8 AWG: Solderless type with a metallic insert connector within a plastic insulating cover having a temperature rating of 105 degC, 600 volts.

1. Manufacturer: Provide one of the following:

a. Buchanan
b. Ideal
c. Scotchlok

D. Connectors for 3-Way Splicing Conductors No. 6 AWG and Larger: Uninsulated solderless compression type.

1. Manufacturer: Provide one of the following:

a. Burndy YST-XXXX
b. Thomas & Betts 54700 Series

E. Connectors for termination of motor loads to branch circuits: Set screw type, clean insulation for termination inspection multitap.

1. Manufacturer: Provide one of the following:

a. Burndy Clear UNITAP
b. Thomas & Betts CSB

2.3 LUGS FOR TERMINATING COPPER CONDUCTORS

A. Lugs for Terminating Power Conductors Up To and Including No. 8 AWG: Solderless type, manufacturer's standard, unless otherwise specified.

B. Lugs for Terminating Power Conductors No. 6 AWG and Larger: Solderless compression type, one hole for No. 6 AWG through No. 4/0 AWG inclusive, and two hole for larger sizes.

1. Manufacturer: Provide one of the following:

a. Burndy Type YA-L
b. Thomas & Betts Series 54000

C. Lugs for Terminating Control and Switchboard Wiring: Solderless compression type with tinned ring tongue.

1. Manufacturer: Provide one of the following:

a. Burndy "Hylug"
b. Thomas & Betts "Sta-Kon"

2.4 TERMINAL BLOCKS

A. Terminal Blocks for Use in Control Wiring of Control Panels and Terminal Cabinets: Molded barrier type rated 30 amperes, 600 volts, with washer head binding screws and white marking strip.

1. Manufacturer: Provide one of the following:

a. Cutler-Hammer, Inc., Bulletin 10987

b. General Electric EB-5
c. Marathon 2000 Series

2.5 INSULATING TAPE

A. General Use Tape:

1. Tape shall be vinyl all weather designed for continuous operation in -18°C to 105° applications and shall be 7 mils thick.
2. Manufacturer: Provide one of the following:

a. Okonite Type CLF Catalog Series 602-20
b. 3M Scotch Super 33

2.6 MISCELLANEOUS

A. Wire Labels for Identification of Conductors.

1. Manufacturer: Provide products of one of the following:

a. Brady
b. Westline

B. Lubricating Compound:

1. Manufacturer: Provide products of one of the following:

a. American Polywater Corporation
b. Ideal 77 Yellow
c. Wire Lube

PART 3 - EXECUTION

3.1 GENERAL

A. Install all wiring in raceway systems unless otherwise specified. Install wiring only in completed raceway systems and when systems are protected from the weather. Install conductors continuous, without splices, between equipments, where possible. Where splices are required, make up splices in boxes; do not use fittings for same.

B. Install phase and neutral conductors of each branch or feeder circuit in a single conduit except where paralleling circuits are indicated. Install paralleling circuits of identical makeup and length as the paralleled circuit, and terminate conductors at the same location, mechanically and electrically, at both ends, to ensure equal division of the total current between conductors.

C. All 120 volt branch circuits exceeding 100 feet in length shall be minimum size #10 AWG.

D. All 277 volt branch circuits exceeding 200 feet in length shall be minimum size #10 AWG.

E. For interior branch circuits, provide a separate neutral conductor for each phase conductor for circuits supplying 120 volt convenience receptacles, fluorescent ballasts and high intensity discharge ballasts. Sharing neutrals between phase conductors shall not be permitted.

F. Continuously lubricate all non-armored cables of the larger sizes at the pull-in point of conduit systems with an approved compound compatible with conductor insulation or jacket.

G. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by IPCEA and/or the manufacturer. Do not exceed manufacturer's recommended values for maximum pulling tension applied to any wire or cable.

H. Connect all power wiring to equipment such that phasing shall be A-B-C-N left to right, top to bottom and front to back, where possible, and permanently identify phasing on the structure or housing adjacent to bus. Phase identification A-B-C is equivalent to transformer phase identification X1-X2-X3 and H1-H2-H3.

I. Connect phase wiring to all 3 phase receptacles to insure the same phase rotation in all receptacles with interchangeable plugs.

3.2 COLOR CODING, CONDUCTOR AND CABLE IDENTIFICATION

A. Provide single conductor cables having black insulation for power feeders and subfeeders. Identify individual feeder and subfeeder conductors as to phase connection and voltage by means of wire labels and color coding at each pull box, junction box, manhole, handhole, vault, lighting fixture handhole, splice and termination.

B. Refer to Section 260553 “Identification for Electrical Systems” for conductor and cable identification requirements.

3.3 SPLICES AND TERMINATIONS

A. Splice and terminate conductors with connectors and lugs as specified for the specific size and type of conductor. Do not splice armored cable except where cable lengths are limited by reel capacity. Do not splice direct burial cable underground. Indent all compression type connectors and lugs with tools as recommended by the connector or lug manufacturer.

B. Thoroughly clean wire ends before connectors or lugs are applied. Before installing a compression connector or lug on an aluminum conductor, apply an aluminum joint compound to the exposed conductor and wire brush through the compound to remove the aluminum oxide film. Install the connector or lug immediately after wire brushing the conductor.

C. Whenever aluminum or copper lugs are terminated on aluminum bus, use a Belleville washer and two tin or cadmium plated washers, one on each side in combination with aluminum joint compound on all contacting surfaces. Tighten bolts until Belleville washer is flat.

D. Insulate all bare surfaces of conductors with a minimum of four layers (half lap in two directions) of electrical insulating tape. On larger splices and terminals, build up connection with electrical insulating putty before applying tape, to eliminate both sharp edges and voids.

E. Terminate all armored cables at equipment with an approved type of armored cable terminator and terminate cable ground conductors on equipment ground bus. Where splices are required in armored cables, use approved splicing sleeves. Locate splicing sleeve outside of and adjacent to the tray, not in the tray.

3.4 FIELD QUALITY CONTROL

A. General:

1. Provide visual and mechanical inspection of all cables.
2. Verify that phase identification was provided and its accuracy for each power feeder and subfeeder cable.
3. Verify identification of all lighting circuits and 120 volt circuits on the panel directories.
4. Test and verify thorough operational tests that all lighting and 120 volt circuits perform all the functions for which they were designed.

B. Visual and Mechanical Inspection:

1. Inspect and compare cable data including size and quantity of cables with drawings and specifications. Report differences in test report and include on contractor's "as-built" drawings.
2. Inspect exposed sections of cables for physical damage.
3. Inspect bolted electrical connections for high resistance using one of the following methods:

   a. Use of low-resistance ohmmeter.
   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
   c. Perform thermographic survey.

4. Inspect compression-applied connectors for correct cable match and indentation.
5. Inspect for correct phase identification and phase arrangements.
6. Inspect jacket and insulation condition.

C. Electrical Tests:

1. Perform resistance measurements through bolted connections with low-resistance ohmmeter.
2. Megger Test: Perform insulation-resistance test for each conductor with respect to ground conductors. Test duration shall be one minute. Applied potential shall be as follows:

   a. 500 volts DC for 300 volt rated cable.
   b. 1000 volts DC for 600 volt rated cable. Minimum permissible insulation-resistance.
   c. Tested value shall be 50 megohm for isolated cables and 5 megohms for non-isolated cables.

3. Perform continuity tests to insure correct cable connection.
4. Verify uniform resistance of parallel conductors.

D. Connections: Isolate power cables to be megger tested by opening switches or breakers at each end of cable prior to testing where such disconnecting means exists. Where cables are direct connected without a disconnecting means, do not disconnect cables; test as connected.

E. Acceptance: Cable must pass all inspections and tests.

F. Records:

1. Include the following information in test report on each 480 volt power cable:

   a. Complete cable identification and description of isolation means.
   b. Megger readings, including converted values.
   c. Approximate average cable temperature.

END OF SECTION 26 0519

SECTION 26 0526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Grounding Conductors:

a. For General Use Above and Below Grade: Bare.
b. In Conduit with Phase Conductors: Insulated.
c. For Isolated Grounding Systems for Data Processing and Laboratories: Insulated.

2. Grounding Connections:

a. To Non-Permanently Fixed Equipment: Lugs bolted to the equipment.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Ground electrical system neutrals and non-current carrying parts of electrical equipment per the minimum requirements of the National Electrical Code, except where additional requirements are indicated or specified.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Submit shop drawings and complete product data on each item. Coordinate the items, as they relate to the work, prior to submittal. Shop drawings shall include:

1. Grounding connections and fittings

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. Bare Grounding Conductors: stranded annealed copper.

B. Insulated Grounding Conductors: stranded annealed copper insulated with a heat and moisture resistant polyvinyl chloride compound and meeting UL Requirements for Type (THWN) (XHHW), 75 degC, rated 600 volts, color-coded green. Conductor No. 10 AWG and smaller may be solid in lieu of stranded.

1. Manufacturer: Provide products of one of the following:

a. Southwire
b. Cerrowire
c. Encore
d. General Cable
e. Prysmian

f. Republic Wire

2.2 GROUNDING CONNECTIONS

A. Copper Compression Grounding Lugs Prefilled with Copper Oxide Inhibitor:

1. Manufacturer: Provide products of one of the following:

a. Hubbell/Burndy
b. ABB/Thomas & Betts

B. Grounding Fittings for Bonding a Ground Conductor to Its Own Conduit:

1. Manufacturer: Provide products of one of the following:

a. Appleton Type GIB
b. Burndy Type NE
c. Penn Union Type BD
d. O-Z Type GB
e. Thomas & Betts Type TIG or 3800 Series

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install conductors of size required by the NEC. except that where sizes are otherwise indicated, provide these sizes.

B. Thoroughly clean all bonding surfaces of non-conducting materials. Where bolted connections are used, treat surfaces with a corrosion-inhibiting compound.

C. Where insulated conductors are used, thoroughly tape all exposed splices and connections. Encapsulate below grade splices and connections so that bare conductors are not in contact with earth.

D. Where metallic conduit is used for mechanical protection of a ground conductor, bond conductor to the conduit at each end.

E. Where non-metallic conduit is used, install a ground conductor in the conduit with the circuit conductors. The ground conductor may be a separate conductor, a conductor of a multi-conductor cable, or wires in the interstices of cabled circuit conductors. Size the ground conductors per NEC requirements except where noted otherwise.

F. Branch circuits in EMT or flexible conduit and lighting fixture cord and plug assemblies shall have an equipment grounding conductor.

G. Provide an equipment grounding conductor, within the raceway along with phase conductors, for all feeders and branch circuits.

H. The metallic enclosures and exposed noncurrent-carrying metal parts of all electrical equipment shall be grounded by connection with an equipment grounding conductor. This includes boxes, panels, lighting fixtures, ballasts and poles, receptacles, etc.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M and AWS D1.2/D1.2M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Plain steel.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
4. Channel Width: Selected for applicable load criteria.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325.
6. Toggle Bolts: Steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 5000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted [**or other**]support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 5000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 3000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 910 "Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Raceway systems as required, and all equipment and material, including conduit, fittings, boxes, wireways, and cable trays, as indicated or specified.

1.3 SUBMITTALS

A. Product Data: Submit complete data on each item. Coordinate the items, as they relate to the work, prior to submittal. Shop drawings shall include:

1. Conduit and fittings
2. Boxes
3. Wireways

B. Submit Owner's Operation and Maintenance Manuals for systems and equipment as follows:

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Work in Hazardous Areas in accordance with Article 500 of the National Electrical Code.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Galvanized Steel (RGS) Conduit, Elbows, and Couplings: Zinc-coated hot dip galvanized threaded steel per ANSI C80.1 "Specification for Rigid Steel Conduit, Zinc-Coated" and UL6. Each length of conduit shall be threaded on both ends.

1. Manufacturer: Provide products of one of the following:

a. Allied
b. Republic
c. Wheatland

B. Intermediate Metal Conduit (IMC), Elbows and Couplings: Zinc-coated hot dip galvanized per UL 1242. Each length of conduit shall be threaded on both ends.

1. Manufacturer: Provide products of one of the following:

a. Allied
b. Republic
c. Wheatland

C. Electrical Metallic Tubing (EMT): Zinc-coated steel per ANSI C80.3-1977 "Specification for Electrical Metallic Tubing, Zinc-Coated".

1. Manufacturer: Provide products of one of the following:

a. Allied
b. Republic
c. Wheatland

D. Flexible Steel Conduit: Per UL-1, "Flexible Steel Conduit".

1. Manufacturer: Provide products of one of the following:

a. Anaconda
b. Electriflex

E. Liquid-Tight Flexible Steel Conduit: Per UL-1, "Flexible Steel Conduit", with a PVC jacket.

1. Manufacturer: Provide products of one of the following:

a. Anaconda
b. Sealtite
c. Electriflex

2.2 ELECTRICAL PLASTIC CONDUIT

A. Heavy Wall Conduit: Schedule 40, 90 C, UL-rated, construct of polyvinyl chloride (PUC) and conforming to NEMA TC-2, for direct burial, or normal aboveground use, UL-listed and in conformity with NEC Article 347.

B. Conduit and Tubing Accessories: Provide conduit, tubing and duct accessories of types, sizes and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

C. Manufacturers: Provide products of one of the following:

1. Cantex
2. Prime Conduit, Inc.
3. National Pipe

2.3 CONDUIT FITTINGS

A. Fittings for Rigid Galvanized Steel or Intermediate Metal Conduit: Cast or malleable iron bodies, cadmium or zinc-plated, with taper threads, screw attached cover plates, and gaskets when located in areas requiring gaskets as specified in Part 3.

1. Manufacturer: Provide products of one of the following:

a. Appleton Form 35
b. Crouse-Hinds Form 8
c. Steel City/Thomas & Betts
d. Topaz

B. Expansion Fittings for Rigid Galvanized Steel or Intermediate Metal Conduit: Cast or malleable iron bodies, with threaded end caps for receiving fixed and movable conduits, metallic pressure packing and copper bonding jumper assembly, and providing for a minimum of 2 inches movement of the conduit in either direction.

1. Manufacturer: Provide products of one of the following:

a. Appleton Type XJ
b. Crouse-Hinds Type XJ
c. O-Z Type AX
d. Thomas & Betts Type XJG

C. Couplings and Connectors for EMT: Zinc-plated steel, compression or set screw type.

1. Manufacturer: Provide products of one of the following:

a. Appleton
b. ETP
c. Midwest
d. Steel City/Thomas & Betts

D. Conduit Unions on Continuous Run:

1. Manufacturer: Provide products of the following:

a. Erickson

E. Expansion Fittings for EMT:

1. Manufacturer: Provide products of the following:

a. Thomas & Betts Type XJG

F. Fittings for Flexible Steel Conduit: Malleable iron or steel, zinc or cadmium plated, securing the conduit by clamping action around the periphery of the conduit. Do not furnish fittings that anchor the conduit by means of set screws.

1. Manufacturer: Provide products of one of the following:

a. Appleton
b. ETP
c. Steel City/Thomas & Betts

G. Fittings for Liquid-Tight Flexible Steel Conduit: Designed to maintain the liquid-tight feature of the installation.

1. Manufacturer: Provide products of one of the following:

a. Appleton ST Series
b. ETP
c. Thomas & Betts 5331 to 5360

H. Locknuts for Rigid Steel or Intermediate Metal Conduit: Malleable iron or steel, zinc or cadmium plated.

I. Bushings for 1 Inch and Smaller Rigid Steel Conduits, Intermediate Metal Conduits or Aluminum Conduits: Insulating plastic type of non-burnable thermosetting phenolic, conforming to Underwriters' Laboratories requirements. Do not furnish non-rigid plastic bushings.

J. Bushings for 1-1/4 Inch and Larger Rigid Steel or Intermediate Metal Conduits: Malleable iron or steel, zinc or cadmium plated, with insulating insert of thermosetting plastic as specified for smaller conduit bushings, molded and locked into the bushing ring.

2.4 OUTLET BOXES

A. Sheet Steel Boxes: Galvanized or sherardized stock not less than No. 14 gage, with knockout openings, single or multiple gang, with extensions, adapters, plaster rings, tile covers, fixture studs and cover plates. Furnish accessories with same gage and finish as specified for boxes, except where special finishes are specified for covers and device plates in Section 26 2726. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Part 3.

1. Manufacturer: Provide products of one of the following:

a. Appleton
b. RACO
c. Steel City

B. Cast or Malleable Iron Boxes: Galvanized or cadmium plated, single or multiple gang, with taper threaded hubs, adapters and cover plates. Furnish cast metal, galvanized or cadmium plated accessories, except where special device plates are specified in Section 26 2726. Furnish gaskets when located in areas requiring gaskets as specified in Part 3. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Part 3.

1. Manufacturer: Provide products of one of the following:

a. Appleton
b. Crouse-Hinds
c. Pyle-National
d. Russelstoll
e. Steel City/Thomas & Betts

2.5 PULL AND JUNCTION BOXES

A. Boxes Less than 5 Inches by 5 Inches: Conform to requirements specified for Outlet Boxes.

B. Sheet Metal Boxes: Code gage, full seam welded with bent-in flanges seam welded at corner joints, screw fastened cover of same gage as box. Fasten cover with brass machine screws. Galvanize box and cover after fabrication. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in Part 3.

C. Cast or Malleable Iron Boxes: Code gage, with threaded hubs or conduit bosses for field drilling and tapping, screw fastened cover of same gage as box. Fasten cover with brass machine screws. Galvanize box and cover after fabrication. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in Part 3.

1. Manufacturer: Provide products of one of the following:

a. Hoffman
b. O-Z

2.6 FLOOR BOXES AND FITTINGS

A. Refer to Drawings for floor box products.

2.7 SURFACE RACEWAY

A. Where necessary to run exposed on existing walls and/or ceilings in finished areas, use surface raceway series type, as required for each individual circuit, or as shown on drawing. Paint the new surface raceway to match the existing surface (unless pre-finished).

1. Manufacturer: Provide products of one of the following:

a. Hubbell
b. Mono-Systems
c. Wiremold

2.8 MISCELLANEOUS

A. Trapeze Hangers

1. Manufacturer: Provide products of one of the following:

a. Kindorf
b. Powerstrut
c. Unistrut

B. Shielding Paint

1. Manufacturer: Provide products of one of the following:

a. Thomas & Betts "KopR-Shield"

C. Sealant: Single component, non-sage urethane:

1. Manufacturer: Provide products of one of the following:

a. Sika Corporation “Sikaflex 1a”
b. Pecora Corporation "Dynatrol 1"
c. Sonneborn "Sonolastic NP-1"
d. Tremco “Dymonic”

PART 3 - EXECUTION

3.1 CONDUIT SYSTEMS

A. Install EMT conduit for conduit in “unfinished” or “open” areas up to 10’-0” above finished floor.

B. Electrical Plastic Conduit (PVC) for conduits routed below the building floor slab.

C. Install RGS conduits for conduits imbedded in the floor slab. Maximum size of conduits imbedded in floor slabs shall be 1-1/4” diameter unless otherwise specified. Conduits imbedded in floor slabs shall not cross each other.

D. Install RGS conduit for conduit elbows used to transition from below the slab and for all RGS conduit imbedded in the slab to vertical risers passing through the floor slab.

E. Install RGS elbows and conduits for all vertical risers at utility poles and for feeders from pad mount transformers to main secondary switchboards.

F. Install RGS conduits for all exposed exterior locations and wet locations.

G. EMT compression type connectors and couplings shall be used for all EMT conduits routed in damp locations or when the use of EMT in lieu of RGS is approved by the Engineer for exposed exterior locations. The use of set screw connectors and couplings is permitted for all other EMT raceways where equipment ground wires exist.

H. Install EMT concealed in wall cavities in offices and similarly “finished areas,” above suspended ceilings and in “unfinished areas” 10’-0” above finished floor.

I. Install flexible conduit in lieu of RGS or EMT for service to individual recessed fixtures, 1/2 inch minimum size. Use liquid-tight type of flexible conduit in lieu of non-jacketed flexible conduit in damp or wet locations.

J. Install liquid-tight flexible steel conduit for final connection to distribution transformers for final connections to all motors and other equipment subject to vibration or movement. Flexible conduits shall not exceed 6’-0” in length.

K. Install conduit systems as indicated, as required by the NEC, and as specified. Install conduit sizes as indicated. Where conduit sizes are not indicated, install sizes per NEC requirements, except do not use conduit sizes smaller than 3/4 inch. The use of 1/2” conduit is permitted from receptacle outlet boxes and switch outlet boxes to the nearest junction mounted in the ceiling space. 3/4” conduit minimum shall be used from the panelboards to the junction boxes and between junction boxes. Use 1/2 inch fixture stems optionally, unless otherwise indicated.

L. Install conduit concealed in office and similar finished areas, and exposed in all other areas unless otherwise indicated or specified.

M. Install all exposed and concealed conduit runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Keep conduit at least six inches away from parallel runs of high temperature surfaces, such as steam or hot water pipes and do not run conduit directly under cold water lines.

N. Conduits routed below floor slabs shall have a minimum of 3 inches of sand cover and shall not be required to be run parallel to building walls.

O. Group conduit for common support, where indicated and elsewhere as directed by the Architect-Engineer.

P. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Take care to prevent the entrance of water and the lodging of concrete, plaster, dirt or trash in conduit, boxes, fittings and equipment during the course of construction. Free conduit of obstructions or replace the conduits. Where conduit joints occur in concrete slabs, or in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible. Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc. with standard galvanized plumbers pipe caps. Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.

Q. Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings or floors, and fill the void between sleeve and conduit with sealant flush with the end of the sleeve to seal the opening.

1. For conduit sleeves passing through fire rated walls, floors or ceilings, comply with requirements of Section 07 8413 “Through-Penetration Firestop Systems”.

R. Terminate conduit stubbed up through concrete floors for connections to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except that where required, use flexible conduit from a point 6 inches above the floor.

S. Make changes in direction of runs with symmetrical bends, fittings or pull boxes. Do not use bends around outside corners; use fittings for same. Install elbows, bends and offsets having a minimum radius of curvature of 24 inches for 2 inch and 2-1/2 inch conduit, and 36 inches for 3 inch and larger conduit. Except where conduit runs are shown in exact detail, install pull points at not greater than 200 foot intervals in straight runs. Where bends are included between pull points, reduce this maximum permissible 200 foot separation between pull points by 50 feet for each 90 degree bend and 25 feet for each 45 degree bend. Figure deductions for all other angle bends on a similar basis. When bends are made in the field, make bends with an approved hickey or conduit bending machine. Make bends in 1-1/4 inch and larger conduits with standard conduit ells where possible.

T. Provide conduit nipples with two independent sets of threads. Do not use running threads on any part of the conduit system. Where conditions require joining two fixed conduits into a continuous run, use a conduit union, in place of running threads and coupling.

U. Install expansion fittings in exposed conduit runs of excessive length, where conduits cross building expansion joints, and where indicated.

V. Install expansion fittings in straight runs of aluminum conduit at intervals not greater than 80 feet.

W. Paint conduit threads in PVC jacketed rigid steel conduit with shielding paint.

X. Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit the bushing to be fully seated against the end of the conduit.

Y. Use one hole malleable iron galvanized pipe straps for support of single conduits, or clevis type hangers. Support groups of conduit on trapeze hangers. Use threaded rod or pipe for hanger support. Do not use perforated strap or wire for conduit or hanger support. Use beam clamps or malleable iron or wrought steel with hook rods to grip the beam flange for conduit or hanger support; do not use C-clamp type fittings. Support exposed conduit at least every 8 feet if smaller than 2 inch, and every 10 feet if 2 inch and larger unless otherwise noted.

3.2 OUTLET, SWITCH, JUNCTION AND PULL BOXES

A. Outlet Boxes for Use with Rigid Steel Conduit in Non-Hazardous Areas: Sheet steel for flush or concealed work in dry locations; cast or malleable iron in exposed, damp or wet locations. Do not use sheet steel outlet boxes in utility or factory areas.

B. Outlet Boxes for Use with Electrical Metallic Tubing: Sheet steel for flush or concealed work; cast or malleable iron for exposed locations.

C. Flush Mounted Boxes: For single gang outlets and two gang outlets, use boxes not less than 4 inches square and 2-1/8 inches deep with single gang and two gang plaster reducing ring. For multiple outlets, use gang type boxes not less than 2-1/4 inches deep. Plaster rings shall not be less than 3/4 inches deep. For ceiling outlets in concrete slabs, use boxes not less than 3 inches deep.

D. Gaskets: Provide cover gaskets for boxes in damp or wet locations and in factory areas.

E. Pull and Junction Boxes for Use with Each Type of Conduit: As specified for outlet boxes for each conduit type under above paragraphs.

F. Install boxes in the wiring or raceway systems as required for pulling of wires, making connections, and mounting of devices and fixtures.

G. Install extension rings, adapters, raised covers and plaster rings on flush mounted boxes as required. Equip flush mounted boxes in masonry block or tile walls with tile covers.

H. Install separate concealed boxes for semi-flush or recessed fixtures when required by the fixture terminal operating temperature. Make boxes readily accessible on removal of the fixture or provide ceiling access panels as approved by the Architect-Engineer.

I. Locate outlets in offices and other finished areas with due regard for the finish and interior architectural treatment so that outlets are centered with respect to panels, joints or moldings, and so that plaster rings, frames and tile covers are properly located with respect to the finished surface.

J. Install outlets for wall switches controlling lighting on the latch side of door where possible.

K. Support boxes independent of conduit and secure rigidly in place. Install boxes used for fixture support such that they are capable of carrying 100 pounds.

L. In concrete, anchor boxes securely to reinforcing steel and to forms to prevent shifting when concrete is placed.

M. Above suspended ceilings, support boxes to the building steel or structural floor above and independent of the ceiling pads; flush mounted boxes for suspended ceilings fasten boxes to the ceiling support system by bar hanger or other approved support; flush boxes in drywall ceilings fasten boxes to ceiling support system by bar hanger or other approved support system.

3.3 FLOOR BOXES

A. Install floor box such that the cover is flush with floor covering or finish floor as applicable to the area in which the floor box is installed. Install plugs in unused conduit entrances. Install above floor fittings and accessories for services indicated. Install flush plugs in covers where outlets are not installed under this Contract.

3.4 WIREWAYS

A. Install wireways at locations indicated. Where wireways are located on surfaces susceptible to moisture on exterior masonry or concrete walls, do not install wireway in contact with such surfaces; support wireways with not less than 1/4 inch air separation from the surface.

B. Provide supports at a maximum of 5 foot intervals.

C. Where pendant supports are indicated or required, provide 1/2 inch diameter threaded rods with beam clamps as specified for conduit supports. Provide lateral bracing at not greater than 10 foot intervals.

END OF SECTION 26 0533

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment identification nameplates
2. Raceway identification
3. Power and control cable identification
4. Floor marking tape
5. Underground-line warning tape
6. Warning labels and signs
7. Instruction signs
8. Cable ties
9. Miscellaneous identification products

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 [and IEEE C2].

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Engraved, Plastic Laminate or Laminated Acrylic: Punched or drilled for screw mounting. Black engraved letters on a white face. Minimum letter height shall be 1/4 inch.

2.2 RACEWAY IDENTIFICATION

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits as specified voltages:

1. Black letters on a yellow field for 250V or less.
2. Black letters on a red field for over 250V and less than 600V.
3. Black letters on an orange field for circuits over 600V.
4. Legend for Systems below 600V: Indicate voltage.
5. Legend for systems over 600V: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3 inch high letters on 20 inch centers.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4 inch black stripes on 10 inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.3 POWER AND CONTROL CABLE IDENTIFICATION

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 FLOOR MARKING TAPE

A. 2 inch wide, 5 mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4 inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50 foot maximum intervals in straight runs, and at 25 foot maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Equipment Identification Nameplates: On each unit of equipment, install unique designation label that is consistent with one line diagram tag nameplates, wiring diagrams, schedules, and the Operation and Maintenance Manual

1. Labeling Instructions:

   a. Indoor and Outdoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/4 inch high letters on 1-1/2 inch high label.
   b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   c. Fasten nameplates with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

   a. Feeder breakers
   b. Feeder switches
   c. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   d. Panelboards: Both panelboard identification label and typewritten directory of circuits.
   e. Enclosures and electrical cabinets
   f. Access doors and panels for concealed electrical items
   g. Emergency system boxes and enclosures
   h. Push-button stations
   i. Contactors
   j. Remote-controlled switches, dimmer modules, and control devices

3.3 RACEWAYS AND CONDUCTOR IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits 100 amperes or more and 120 volts or more to ground:

1. Self-adhesive vinyl tape applied in bands. Install labels at 30 foot maximum intervals.

B. Accessible Raceways, Cables, Junction Box Cover Plates and Pull Box Covers:

1. Self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

   a. Emergency power
   b. Power
   c. UPS

C. Conductor Identification, 600 V or Less:

1. Identify individual phase conductors, neutral conductor and ground conductor of branch power and lighting circuits as to phase and system voltage by means of color coding in conformance with Sections 200-6 and 210-5 of the NEC.

2. Use the following identification scheme unless there are existing schemes being utilized by the Owner:

Phase			Neutral		Equipment Grounding Conductor	System
A	**B**	**C**	**Normal Power**	**Emergency Power**		
X	Y	Z	N	N	GRD.	Any Voltage
Black	Red	Blue	White	White/Red tracer	Green	120/208 Volt
Brown	Orange	Yellow	Gray	Gray/Red tracer	Green/Yellow Tracer	277/480 Volt

3. Where color schemes deviate from above, submit color schemes for approval of the Architect-Engineer prior to implementation. Provide conductor color coding by means of colored insulating materials or by means of colored wire labels attached to individual conductors in all outlet, pull or junction boxes and at all terminations.
4. Install color coding scheme labels at each switchboard, panelboard, distribution panel, power panel and motor control center.
5. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Identify cable groups and conduit at entering and leaving locations in manholes, handholes and at terminations.

E. Tags shall be 1/8 inch thick lead die-stamped tags with punched ears. Fasten tags around the cable group or conduit with No. 12 AWG copper wire.

F. Identify cables in cable tray at intervals of 40 feet, at each side of walls, and at terminations and splices by means of strip aluminum with raised letters.

G. Identify cables entering or exiting conduits, passing through pull boxes, at each pullbox and at each termination location.

H. Designate source and load, or feeder or cable identification on tags. Submit identification for the approval of the Architect-Engineer.

I. Auxiliary Systems Conductor Identification:

1. Identify field-installed alarm, control, and signal connections.
2. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
3. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
4. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Underground Lines:

1. Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication:

1. Install floor marking tape to show working clearances in the direction of access to live parts.
2. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

   a. Power transfer switches.
   b. Controls with external control power connections.

M. Operating Instruction Signs:

1. Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Install instructional sign using adhesive-film-type labels.

O. Emergency Operating Instruction Signs:

1. Install instruction signs with white legend on a red background with minimum 1/4 inch high letters for emergency instructions at equipment used for power transfer or load shedding.

END OF SECTION 26 0553

SECTION 26 0923 – LIGHTING CONTROL DEVICES

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. The objective of this section is to ensure the proper installation of the following lighting control devices:

   a. Line voltage wall switch occupancy sensors
   b. Emergency power transfer devices

2. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensors, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system with automatic emergency power transfer, as described herein.
3. The occupancy sensor based lighting control devices shall accommodate all conditions of space utilization and all irregular work hours and habits.
4. The location and quantities of sensors shown on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. Provide additional sensors as required to properly and completely cover the respective room.

1.3 SUBMITTALS

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

B. Shop Drawings: Provide installation details for occupancy and light-level sensors.

1. Lighting plans indicating location, orientation, and coverage area of each sensor and each power transfer device. The locations and quantities of sensors and transfer devices indicated on the Drawings are diagrammatic and indicate only the rooms which are to be provided with sensors and emergency lighting. Provide layout shop drawings indicating all power transfer devices and all sensors including any additional sensors required to properly and completely cover the respective areas. Include locations of power transfer devices (PTD).
2. Interconnection diagrams showing field-installed wiring.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.4 WARRANTY

A. Contractor shall warrant all equipment furnished in accordance with this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The suppliers obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty shall be for a minimum period of one (1) year.

1.5 QUALITY ASSURANCE

A. 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.

B. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

C. All components shall be U.L. listed and meet all state and local applicable code requirements.

D. Wall switch products shall be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

E. It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with the occupancy sensor system.

F. It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the occupancy system. A minimum of four (4) hours at the jobsite building shall be included for training.

1.6 COORDINATION

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

B. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.

PART 2 - PRODUCTS

2.1 WALL SWITCH OCCUPANCY SENSOR

A. Switching mechanism shall be latching air gap relay, compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices shall not be allowed. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the sensor's longevity.

B. Sensor shall be capable of detecting presence in the control area by detecting changes in the infrared energy. Small movements shall be detected such as when a person is writing while seated at a desk.

C. To avoid false ON activations and to provide high sensitivity to minor motion, Pulse Count Processing and Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of the signal received by the sensor to ensure response only to those signals caused by human motion.

D. Sensor shall utilize signal technology to provide immunity to RFI and EMI.

E. Sensor shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. Fresnel lens shall be a Poly IR 4 based material to offer superior filtering capability of competing light sources, such as the sun and other visible light sources. Lens shall have grooves facing in to avoid dust and residue build-up which could affect IR reception. To assure detection at the desktop level uniformly across the space, sensor shall have a 2 level, 28 segment, multi-element Fresnel lens system. For protection against lens damage, sensor shall utilize a full radius lens brace.

F. Sensor shall have a coverage area of 900 sq. ft. for walking motion, with a field of view of 180 degrees.

G. Sensor shall operate at either 120 VAC or 277 VAC and shall be capable of switching 0 to 800 watt ballast or tungsten or 1/6 hp @ 120 volts, 60 Hz; 0 to 1200 watts for ballast or 1/3 hp @ 277 volts, 60 Hz.

H. Sensor shall have a built-in light level feature adjustable from 2 to 200 footcandles that holds lighting OFF when a desired footcandle level is present. Sensor shall have a time delay adjustable from 30 seconds to 30 minutes. Sensor shall have user-adjustable sensitivity setting. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering of adjustments and hardware.

I. Sensor shall have two positions only: OFF and AUTO for normal operation.

J. The sensor shall utilize terminal style wiring. Sensor shall provide automatic equipment grounding to a metal junction box, and provide grounding to a metal cover plate.

K. Sensor shall have 100% off switch with no leakage current to load in OFF mode. In the event there is an open circuit in the AC line such as a ballast or lamp failure, the sensor shall automatically switch to OFF mode.

L. Manufacturer: Provide the following:

1. Leviton
2. Sensor Switch WSD
3. Watt Stopper WS-200
4. Greengate/Cooper/Eaton

2.2 UNIT EMERGENCY POWER TRANSFER DEVICE (PTD)

A. Device shall be UL924 Listed and NEMA 1 plenum rated, suitable for installation on standard junction box with 1/2" threaded nipple. Device shall automatically activate emergency lighting loads upon loss of normal power, bypassing local switched and dimming controls (including 0-10V based). Devices shall be designed for fail-safe operation and be provided with integral LED status lights indicating availability of normal and emergency power and status of the connected load. Device shall be rated for 600V, 120-277V operation, and 16A at 277V.

B. Refer to drawings for exact quantity and locations.

C. Manufacturer: Provide products of one of the following:

1. Bodine; BLCD16DIM

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: No. 12 AWG (minimum), complying with Division 26 Sections.

B. Power Wiring to Supply Side of Emergency Power Transfer Devices No. 12 AWG (minimum), complying with Division 26 Sections.

C. Control wiring between sensors and control units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated and TEFLON jacketed cable suitable for use in plenums.

D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the room which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

B. It is the contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment shall be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

D. Sensors or Power Pack shall have one spare contact in each room for HVAC control.

3.2 EMERGENCY POWER TRANSFER DEVICE INSTALLATION

A. Install PTD in accessible ceiling locations, labeled with area served. Install caution labels indicating two power sources at the device and at each load or fixture supplied by the device. Extend independent emergency raceway and wiring to emergency fixtures.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Sections. All wiring shall be installed in conduit. Minimum conduit size shall be ¾ inch.

B. Wiring Within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Sections.

B. All emergency power systems junction box covers, conduit couplings and panels shall be painted orange.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustment and sensor placement to ensure a trouble-free occupancy-based lighting control system. This service shall be provided with the base bid contract.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten (10) working days written notice of the scheduled commissioning date.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two (2) visits to site outside normal occupancy hours (4 hour minimum duration each) for this purpose.

END OF SECTION 26 0923

SECTION 26 0943 – LOCALLY NETWORKED LIGHTING CONTROLS

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 Work of this Section.

1.2 DESCRIPTION OF SYSTEM

A. These Specifications, together with the related Drawings and General Conditions of the Contract, comprise the requirements for the lighting control system.

B. Summary:

1. The lighting control system shall provide sensor-based and manual lighting control.
2. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed).
3. All system devices shall be capable of being networked together enabling digital communication and shall be individually addressable.
4. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity if network connectivity to the network system is lost.
5. The system shall not require any centrally hardwired switching equipment for normal operation.

C. The lighting control system shall include de-centralized lighting control modules, control stations, control processing units and other user interface devices, wiring, and ancillary programming equipment. Type of lighting control equipment and wiring specified in this section includes the following:

1. Bridges/hubs
2. Control modules for relay control, dimming control and constant power ballasts
3. Digital dimmer control
4. Digital dimming control stations
5. Digital low voltage control stations
6. Digital relay control
7. Gateways
8. Hardwired low voltage control
9. Low voltage control packs
10. Occupancy sensors
11. Power/relay packs
12. Software

D. Abbreviations/Definitions:

1. Bridge: A digital device which connects lighting control zones to a network backbone.
2. Control Modules: Pre-assembled components that consist of digital control relays, fully rated line voltage lighting control relays, dimmer modules, circuit breakers, or other lighting control devices for use inside the lighting control panels.
3. Digital Dimming Control Stations: User interface pushbuttons (typically wall mounted) with a discrete address which transmit a low voltage digital signal via the communication bus to the CPU to initiate a selected dimming action at a preset rate for a preselected group of fixtures.
4. Digital Low Voltage Control Station: User interface pushbuttons (typically wall mounted) with a discrete address which transmit a low voltage digital signal via the communication bus to the bridge to initiate a selected on/off action for a preselected group of fixtures.
5. Graphic Wall Station: Wall mounted touchscreen graphic user control device with a discrete address capable of configuring scenes and establishing and controlling presets.
6. Low Voltage Control Pack: Device which accepts communication inputs, assigns an address to that device, which establishes a zone and provides 0-10 VDC.

7. Occupancy Sensors: Devices with a discrete address which detect room occupancy status via infrared or microphone, or a combination of infrared and either ultra sonic or microphone technologies and transmit digital signals via the communication bus to the bridge to initiate a selected on/off action for a preselected group of fixtures.
8. Power/Relay Pack: Device which accepts communication inputs, assigns an address to that device which establishes a zone and has 120/277 volt load rated contacts. When specified, this device also provides 0-10 VDC and line voltage dimming.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated including, but not limited to:

1. Physical dimensions, sequence of operation, types and quantity of modules being provided, and spare capacity of modules.
2. Control stations and plate color and material.
3. Communications cabling.
4. Certification letter indicating ballasts/power supply and light source combinations compatible with dimmer controls.
5. Operational documentation for software and firmware.
6. Start-up worksheets to be used.
7. Commissioning plans, schedule and worksheets to be used.

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.

1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
2. Front elevations of all control panels and control stations including the customized legends on each device.
3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines. Indicate control zone to correspond to plan drawings and specification sequence of operation.
4. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
5. Riser diagrams depicting all devices and wiring.
6. Modifications to existing floor plans depicting any circuiting revisions or device locations (occupancy sensors, daylight sensors, etc.).
7. Modifications to panelboard schedules to maintain proper circuit loading and phase balancing.
8. Plan drawings indicating locations and interconnections of all components.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For control modules, control stations, normal system operation, emergency system, operation, and maintenance manuals. In addition to items specified in Division 1 Sections include the following:

1. Software manuals.
2. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
3. Operation of adjustable zone controls.
4. Testing, operation and adjusting of panic and emergency power features.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain dimming controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section.

B. Manufactured in the USA.

1.5 COORDINATION

A. Coordinate lighting controls with Sections specifying distribution components that are monitored or controlled by power monitoring, power control equipment, and audio/video systems.

1.6 WARRANTY

A. Special Warranty: Repair or replace components of lighting controls that fail in materials or workmanship within warranty periods specified below.

1. Warranty Period: Cost to repair or replace any parts for five (5) years from the date of Substantial Completion.
2. During the warranty period, provide 24 hours/day 7 days per week telephone technical assistance.
3. During the warranty period, provide 24 hour on-site response time.
4. Failures include, but are not limited to, the following:

    a. Software: Failure of input/output to execute switching or dimming commands.
    b. Failure of modular relays to operate under manual or software commands.
    c. Damage of electronic components due to transient voltage surges.
    d. Failure to switch relays to "on" status and to switch dimmer modules to full light output in power failure mode.
    e. Failure or damage to pushbutton stations due to human use/abuse.

5. Provide software upgrades for all lighting control systems during the warranty period.

1.7 SPARE PARTS

A. Furnish spare parts described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Bridges: Provide two (2) spares.
2. Dimming and Low Voltage Control Stations: Provide one (1) spare of each type installed.
3. Gateways: Provide one (1) spare.
4. Occupancy sensors provide five (5) spares.
5. Power/Relay Packs: Provide two (2) spares.

1.8 DELIVERY, STORAGE AND HANDLING

A. Package for delivery to best protect finish surfaces while using the least amount of single-use packaging as possible. If possible, package and ship product using reusable blankets and fabrics or reusable cardboard and crate systems.

B. Protect materials against weather and contact with damp or wet surfaces from time of delivery through time of installation. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.

C. When storing prior to installation, raise off floor on pallets, stack flat with protective material between to eliminate chance of creating nicks, scratches, and other imperfections and damage to finish surfaces, wrap weather-tight, and provide for air circulation within and around stacks and under temporary coverings.

D. Do not allow materials to become damp. Maintain temperatures at 60°F or higher, and humidity between 20% and 60% prior to, during and after installation.

1.9 CODES AND STANDARDS

A. IEEE Standard 2000.1-1998

B. UL 916 Energy Management Equipment

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a UL/CUL testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.

E. UL 924 Emergency Lighting

F. ASHRAE 90.1-2013 as adopted by Michigan Energy Code 2015.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acuity Brands, Sensor Switch, nLight network control system
2. Cooper; Greengate Room Controllers
3. Hubbell NX

2.2 SYSTEM DESCRIPTION

A. The lighting control system shall provide seamless control and monitoring of all lighting fixtures included in the scope of work regardless of whether it is relay switched or dimmer controlled and switched or controlled via communication-based 0-10 VDC equipment.

2.3 COMMUNICATION BRIDGES

A. Device shall surface mount to a standard 4” x 4” square junction box and plenum rated.

B. Device shall have 8 RJ-45 ports.

C. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to the gateway.

D. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5e cabled connection.

E. Device shall redistribute power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to impact on network lighting control system.

F. Devices shall be provided in sufficient quantities to assume that each device has two free ports after all CAT-5e cabling is installed.

2.4 NETWORKED SYSTEM WALL SWITCHES AND DIMMERS

A. Devices shall be recessed into single-gang switch box and fit a standard GFI opening.

B. Devices shall be available with zero or one integrated Class 1 switching relay.

C. Communication and low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.

D. All sensors shall have two RJ-45 ports minimum.

E. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.

F. Devices shall be white.

G. Devices with dimming control outputs shall control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).

H. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.

I. Devices with mechanical push-buttons shall provide tactile and LED user feedback.

J. Devices with mechanical push-buttons shall be made available with custom button labeling

K. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

2.5 NETWORKED SYSTEM OCCUPANCY SENSORS

A. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.

B. Sensors shall be available in multiple lens options which are customized for specific applications.

C. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

D. All sensors shall have multiple RJ-45 ports or capable of utilizing a splitter.

E. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.

F. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5e cabling.

G. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.

H. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.

I. Wall switch sensors shall meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

J. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.

K. Wall switch sensors shall be white.

L. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.

M. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.

N. Embedded sensors shall be capable of both PIR and Dual Technology (PIR/microphonic) occupancy detection. Occupancy sensors utilizing ultrasonic technology are not acceptable.

O. Embedded sensors shall have an optional photocell.

P. Network system shall consist of ceiling, fixture, recessed, and corner mounted sensors.

Q. Fixture mount sensors shall power themselves via a line power feed.

R. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.

S. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

T. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output.

U. All sensors shall be provided with an isolated relay (integral or remote) for use by Mechanical Controls Contractor.

2.6 NETWORKED SYSTEM POWER/RELAY PACKS

A. Power pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

B. Power packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.

C. All devices shall have two RJ-45 ports minimum.

D. Every power pack parameter shall be available and configurable remotely from the software and locally via the device push-button.

E. Power pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. UL Listing under Energy Management or Industrial Control Equipment meets this requirement.

F. When required by local code, power pack shall be installed inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

G. Combination power packs shall provide up to 5 amps switching of all lighting load and as 0-10 VDC dimming or fluorescent ballasts/LED drivers.

H. Specific secondary packs shall consist of up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).

I. Specific secondary packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.

J. Specific Secondary Packs shall be available that control small equipment such as louver/damper motors.

K. Specific secondary packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

2.7 NETWORKED SYSTEM GRAPHIC WALL STATION

A. Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.

B. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.

C. Device shall enable user supplied .jpg screen saver image to be uploaded.

D. Device shall surface mount to single-gang switch box.

E. Device shall have two RJ-45 ports for communication.

2.8 NETWORKED SYSTEM SCENE CONTROLLERS

A. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.

B. Device shall recess into single-gang switch box and fit a standard GFI opening.

C. Devices shall provide LED user feedback.

D. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.

E. All sensors shall have multiple RJ-45 ports.

F. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.

G. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).

H. Device shall have LEDs indicating current selection.

2.9 START-UP AND SUPPORT FEATURES

A. All devices daisy-chained together (using CAT-5e) shall automatically be grouped together into a functional lighting control zone for system start-up.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

C. All system devices shall be capable of being given user defined names.

D. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

2.10 LIGHTING CONTROL SEQUENCE OF OPERATION

A. Refer to Drawings for room specific sequences of operation.

B. Power Interruption and Fire Alarm Event

1. Power interruption will automatically over-ride the current setting and bring all emergency egress lighting to 100% output.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all equipment at locations indicated, and secure to ceilings, walls, floors or structural members as required.

B. Provide special cable as indicated or specified by manufacturer.

C. Install all wiring in conduit systems as indicated and as specified in Section 260533.

D. Provide final wiring and connections per the manufacturer's wiring diagrams.

E. Provide a dedicated power feed to each power supply.

F. Communication bridges shall be installed in electrical closets, telecommunications closets, or above lay-in ceilings at doorways at strategic locations. Gang bridges where possible to minimize 120volt wiring and to centralize their location for maintenance. They shall not be installed in spaces with open ceiling construction.

G. Provide 120 volt power to each gateway and bridge provided.

H. I/O devices and power packs for emergency lighting circuits shall be UL 924 rated.

I. System Programming: The system shall be turned over to the Owner programmed and ready for immediate operation. It shall be the responsibility of the contractor to coordinate with the Owner and supply the necessary “as-installed” information and schedule requirements for system programming in a timely manner.

3.2 QUALITY CONTROL

A. Independent Testing Laboratory: The control panels shall be tested and listed under the UL 916 Energy Management Equipment standards.

B. System Checkout and Training: A factory authorized technician shall functionally test the system and verify performance after contractor installation. Provide training (8 hours minimum) for operations personnel on the set-up, programming, operation and maintenance of the lighting control system. The training shall be executed in two (2), four (4) hour sessions on separate dates as directed by the Owner.

C. Adjusting: After completion of system wiring, connect, test, adjust, and readjust as necessary, all equipment in terms of design function and performance.

D. Demonstration: After checking has been completed and system is operational, demonstrate to the Owner the complete and correct functioning of all system components and equipment. These demonstrations shall consist of operating the controls through their normal full ranges and sequences. Simulate abnormal conditions to demonstrate proper functioning of the devices. Readjust settings to their correct design values and, after sufficient time, observe ability of controls to establish the desired conditions, noting abnormal deviations. Make necessary repairs, replacements or adjustments on items which fail to perform satisfactorily and repeat tests to demonstrate compliance with the design intend.

   1. When system is in specified operational condition, and when pertinent operational functions have been demonstrated, system shall be accepted.

E. Test all life safety lighting control panels by simulating a power failure to the lighting panelboards serving the normal lighting in the space. Verify and make any adjustments to assure that if power fails in those panelboards or if the transfer switch changes states the life safety lighting control panels shall energize relays and all dimmers energize to full light output.

3.3 START UP SERVICES

A. Provide “on-site” start up services to assist contractor in making final connections, programming, preparing schedules, aiming photo sensors, installing photo sensors, installing occupancy sensors and installing all the electronics.

3.4 TRAINING

A. Provide “on-site” training for the Owner’s operation and maintenance staff.

3.5 COMMISSIONING

A. The Contractor shall commission the entire lighting control system consisting of testing and documenting all results. The tests shall consist of visiting each space and validating that the quantity, type of fixtures, voltage and wattage are documented in the administrative/trending software package.

B. Program each zone to validate that lighting levels in the spaces are uniform and that the lighting levels remain uniform with daylight harvesting in operation.

C. Validate that each photo sensor, occupancy sensor and pushbutton operate as specified and required. Document each device with its IP address and the room and group of fixtures it controls.

D. Test each space for operation during scheduled “on” hours and then for scheduled "off" hours to assure controls operate as intended. Document spaces and times when the spaces were tested.

E. Simulate a power outage to validate all emergency lighting operates as required.

F. Provide a testing procedure 90 days prior to work and a schedule of testing times 30 days prior to commencing.

G. Notify engineers five (5) business days prior to commencing testing for his witness of the testing in related areas and related times.

3.6 PRODUCT SUPPORT AND SERVICE

A. 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.

B. Factory telephone support shall be available at no cost to the Owner during the warranty period and extended 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.

END OF SECTION 26 0943

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Lighting control and receptacle services as required, and all materials and equipment, including switches, receptacles, device plates, multi-outlet assemblies, photoelectric controllers, time switches, lighting contactors and low voltage control systems, as indicated or specified.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: Submit product data on each item. Coordinate the items, as they relate to the work, prior to submittal. Include the following:

1. Wall switches and plates
2. All receptacles including device plates.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Switches for Controlling Lighting Directly on AC Systems in General: Toggle-operated, match existing color, specification grade, composition base, heavy duty, flush, quiet type, with provision for back and side wiring, and rated 20 amperes, 120/277 volts AC.

1. Manufacturer: Provide one of the following:

a. Arrow-Hart 1990 Series
b. Bryant 4900 Series
c. General Electric GE5950 Series
d. Hubbell 1220 Series
e. Pass & Seymour 20AC Series

2.2 CONVENIENCE RECEPTACLES

A. 15 Ampere Duplex Convenience Receptacles for 120 Volt, Single Phase Service: Two straight blade, 2 pole, 3 wire, NEMA configuration 5-15R receptacles rated 15 amperes, 125 volts, NEMA performance standard, specification grade, for back and side wiring, match existing color.

1. Manufacturer: Provide one of the following:

a. Arrow-Hart 5262
b. Bryant 5262
c. General Electric GE4065-1
d. Hubbell 5262
e. Pass & Seymour 5262

B. 20 Ampere Duplex Convenience Receptacles for 120 Volt, Single Phase Service: Two straight blade, 2 pole, 3 wire, NEMA configuration 5-20R receptacles rated 20 amperes, 125 volts, NEMA performance standard, specification grade, for back and side wiring, match existing color.

1. Manufacturer: Provide one of the following:

a. Arrow-Hart 5362
b. Bryant 5362
c. General Electric GE4108-1
d. Hubbell 5362
e. Pass & Seymour 5362

C. 20 Ampere Duplex Ground Fault Circuit Interrupter (GFCI) Convenience Receptacles for 120 Volt, Single Phase Service: Two straight blade, 2 pole, 3 wire grounding, NEMA configuration 5-20R receptacles rated 20 amperes, 125 volts, NEMA performance standard, specification grade, with provisions for back and side wiring, match existing color.

1. Units shall have a test and reset button on the face of the receptacles and visible indication of a tripped condition.
2. Units shall have line and load terminal screws such that connection to load terminals shall provide feed through ground fault protection for “downstream” receptacles and/or loads connected to these terminals.
3. All receptacles shall be Underwriters’ Laboratories, Listed under 498 Receptacle requirements and 943 Class A requirements.

a. Manufacturer: Provide one of the following:

1) Arrow-Hart GF5342
2) Bryant GFR53FT
3) Hubbell GF5362
4) Pass & Seymour 2091-S

D. USB Chargers and 20 Ampere Duplex Convenience Receptacles for 120 Volt, Single Phase Service: Two USB charging ports shall be 5 volts DC 3.1 amps minimum combined total, compatible with USB type 2.0 and 3.0 devices. Two straight blade, 2 pole, 3 wire, grounding, tamper resistance receptacles, 125 volt, specification grade, with provisions for back or side wiring, white color. Comply with UL Standard 498 Heavy Duty Grade and UL1310 Standard for Class Power Units, NEMA Performance Standard WD-1 and Federal Specification WC596F.

1. Manufacturer: Provide one of the following:

a. Arrow-Hart TR7756
b. Bryant USBB20W
c. Leviton T5832
d. Hubbell USBB20X2W
e. Pass & Seymour TR5362USB

2.3 DEVICE PLATES

A. Device Plates in Offices and Other Finished Areas: Stainless steel No. 302 finish.

B. Device Plates in Factory, Utility and Similar Areas: Zinc or cadmium plated steel.

C. Device Plates in Wet or Damp Areas and Outdoors: Weatherproof type. Provide spring-hinged gasketed covers on outdoor receptacles suitable for wet locations as defined in NEC Article 406.8.

D. Screws: Provide screws having a finish matching the plate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount equipment at locations indicated.

B. Install receptacles and switches in outlet boxes as specified in Section 26 0533 "Raceways and Boxes for Electrical Systems" unless otherwise specified in this Section. Mount receptacles and switches at uniform heights above the floor for various areas as indicated.

C. Install plates on flush mounted outlets with all four edges in continuous contact with finished wall surfaces without the use of plaster mats or similar devices. Do not use plaster or similar fillings. Install plates vertically, unless otherwise noted, with an alignment tolerance of 1/16 inch.

END OF SECTION 26 2726

SECTION 26 5100 - INTERIOR LIGHTING

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. Lighting systems as required, and all materials and equipment, including lighting fixtures, accessories and associated systems and equipment, as indicated or specified.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Certified results of independent laboratory tests for fixtures and light sources for electrical ratings.
3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
4. Power supplies (ballasts, drivers, etc.).
5. Light sources.
6. Sample Warranties: One (1) for each manufacturer provided.

B. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Fixtures 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 location and application.

B. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs and emergency lighting and OFS Policy No. 2-19 referencing Section 5-9.2.1 of NFPA 101.

C. Regulatory Requirements:

1. Furnish lighting fixtures and other equipment, including all modifications thereto and component electrical parts, listed by Underwriters' Laboratories as meeting National Electrical Code requirements and bearing the UL Label where such service is available for equipment specified.
2. All lighting fixtures with plastic lenses shall comply with the Michigan Department of State Police, Fire Marshal Division, Policy Letter 11-6, dated March 24, 1992, applying to schools, colleges, hospitals, institutions, nursing homes, etc. Shop drawings and product data fixture cuts of such fixtures shall be accompanied by an approved certification stating compliance with the above ruling for forwarding to the State Fire Marshal by the Architect/Engineer.

D. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer’s laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

E. Luminaire Photometric Data Testing Laboratory Qualifications: Providede by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

F. Provide luminaires from a single manufacturer for each luminaire type.

G. LED Fixtures:

1. Each LED luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
2. For fixtures with replaceable screw-in style retrofit LED lamps, provide factory-applied label complying with UL 1598.
3. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

   a. Label shall include the following lamp characteristics:

      1) "USE ONLY" and include specific lamp type.
      2) Lamp diameter, shape, size, wattage and coating.
      3) CCT and CRI.

4. Recessed luminaires shall comply with NEMA LE 4.
5. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
6. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.5 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

C. Warranty Period: Five years from date of Substantial Completion.

1.7 SPARE COMPONENTS

A. LED Light Source: For each fixture type, provide spare replacement LED modules matching 10% of the installed fixture quantity, but not less than two (2). LED modules to match modules installed in associated fixture type (manufacturer, CRI, CCT, output).

B. Diffusers and Lenses: One (1) for every 20 of each type and rating installed. Furnish at least one (1) of each type.

C. Power Supplies (Ballasts and Drivers): For each fixture type, provide spare replacement power supply matching 10% of the installed fixture quantity, but not less than five (5). Power supply to match power supplies in associated installed fixtures.

D. Spare components shall be packaged in sealed manufacturers factory packaging and clearly labeled with:

Project Name
Fixture Type and Catalog Number
Spare Component

All spare components shall be provided with manufacturer's installation/replacement instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Lighting Fixture Schedule on the drawings. No substitutions or alternates shall be accepted for lighting fixtures.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Electromagnetic Interference Filters: Integral to fixture assembly. Provide one filter for each power supply. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.

E. Lenses: Prismatic lenses on recessed fixtures shall be acrylic and shall not be less than 0.125 inches in overall thickness. Lenses on LED fixtures shall render individual LED nodes indiscernible. Refer to lighting fixture schedule.

2.3 POWER SUPPLIES

A. LED Drivers and Power Supplies:

1. Refer to project lighting fixture schedule for LED driver/power supply requirements.

2.4 EXIT SIGNS

A. As noted in the Lighting Fixture Schedule.

2.5 LAMPS/LIGHT SOURCE

A. Lighting fixture lamps shall be as indicated below and as identified with each fixture type on the lighting fixture schedule.

2.6 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Custom Finishes: Provide factory-applied custom finish to match architectural RAL finish code as indicated on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

G. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

H. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

I. Support for Fixtures in Grid-Type Suspended Ceilings:

1. Install a minimum of four ceiling support system rods or wires independent from the ceiling grid “T” for each fixture. Locate not more than 6 inches from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Tests: As follows:

1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to battery source and retransfer to normal.
4. Report results in writing.

C. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

D. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 26 5100

SECTION 27 1000 – STRUCTURED CABLING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the Division 01 specification section, apply to work of this Section.

1.2 SUMMARY

A. This Specification, in conjunction with the Drawings, establishes the requirements necessary to achieve the intended performance and function of the Structured Cabling Systems (SCS).

B. The SCS consists of information processing, and/or information delivery and distribution equipment integrated together to form a cohesive integrated data system.

C. Provide as part of the bid proposal a complete bill of materials, including catalog cut sheets and equipment configuration for the data system.

D. The SCS shall be comprised of new and existing equipment that is of modern design, and current standard production of the manufacturer.

E. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, Manufacturer's recommendations and the latest edition or revision of all applicable codes and standards.

F. Furnish and install a SCS system incorporating the hardware, equipment, Ethernet LAN, and appropriate testing equipment to perform testing as hereinafter described.

G. Provide any additional items, not specifically mentioned herein, necessary to meet system requirements as specified, without claim for additional payment.

1.3 SYSTEM DESCRIPTION

A. This contract consists of providing new Category 6 cabling to Data locations where indicated on the Drawings. Provide a new 48 port patch panel if necessary to achieve a Cat 6 rating with testing. Existing panels may be re-used and empty ports used if a Cat 6 rating is achievable. It will be the contractor's responsibility to determine which panels to use, as it may possibly be all new, in coordination with the owner to their location on the rack.

1.4 WARRANTY

1. Refer to Specification Section 27 0015, Article 1.7 "GUARANTEE, SERVICE AND TRAINING" for warranty requirements.

1.5 SPECIAL EQUIPMENT INSTALLER QUALIFICATIONS

A. This contractor must meet one of the two (2) following special criteria:

1. Demonstrate that at least 30 percent of installation personnel are BICSI Registered Telecommunications Installers. Of that number, at least 15 percent shall be registered at the Technician Level, at least 40 percent shall be registered at the Installer Level 2, Installer Level 2, Copper or Installer Level 2, Optical Fiber, and the balance shall be registered at the Installer Level 1

OR

2. Demonstrate that all work will be performed by fully qualified personnel having had experience on the installation of this type of system and able to certify that the primary on-site field foreman has no less than fifteen (15) years of continuous experience in this area and have made installations similar to this and of this size or larger. Additionally, 30 percent of installation personnel shall have an average of no less than ten (10) years of continuous experience in this area and have made installations similar to this and of this size or larger.

B. This contractor must include references of similar jobs. Final determination of equipment installer qualifications shall be the decision of the owner and may include inspections of recent work.

1.6 SPARE PARTS

A. None.

PART 2 - PRODUCTS

2.1 GENERAL

A. Description of System:

1. The SCS shall include providing complete operational and tested data wiring to support the network communications needs. The SCS will consist of providing new equipment and utilizing existing equipment as they pertain to the following principle features:

   a. Category 6 Horizontal cabling
   b. Category 6 patch cables
   c. Media outlets and connectors
   d. Cable termination equipment
   e. Testing
   f. Documentation

2. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with NFPA-70 (2011 edition of the *National Electrical Code*®), IEEE C2 2007 (NESC 2007), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards:

   a. ANSI/TIA/EIA Standards

      1) TIA-568-C.0 –Generic Telecommunications Cabling for Customer Premises
      2) ANSI/TIA/EIA-568-C.1 -- Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
      3) ANSI/TIA/EIA-568-C.2 -- Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
      4) ANSI/TIA/EIA-568-C.3 -- Optical Fiber Cabling Components Standard
      5) TIA-569-B -- Commercial Building Standard for Telecommunications Pathways and Spaces
      6) TIA/EIA-606(A) -- The Administration Standard for the telecommunications Infrastructure of Commercial Buildings
      7) J-STD-607(A) -- Commercial Building Grounding and Bonding Requirements for Telecommunications
      8) TIA-526-14A –OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
      9) TIA TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems

3. Install cabling in accordance with the most recent edition of BICSI® publications:

   a. BICSI -- Telecommunications Distribution Methods Manual

b. BICSI – Installation Transport Systems Information Manual
c. BICSI - Electronic Safety and Security Design Reference Manual

B. Refer to Section 27 0015 for additional general requirements.

2.2 CATEGORY 6 CABLING

A. Description of System:

1. The Contractor is responsible for providing a complete and operational structured cabling system. Provide the following principle items:

a. Provide new 1ru and 2u wire management where required.
b. Provide new Category 6 unshielded twisted pair cabling.
c. Provide new Category 6 patch cables.
d. Tone, test, label and certify all new data drops.
e. Provide new data outlets.

B. Products:

1. Horizontal Category 6 Cable:

a. Solid copper, 22 AWG to 24 AWG, 100 ohm balanced twisted-pair, plenum rated Category 6 cables with four individually twisted-pairs with a crossfiller spline, which exceeds the mechanical and transmission performance specifications in TIA-568-C up to 250 MHz and sweep tested to at least 550 MHz. Listed Type CMP. Category 6 cables installed between floors shall be riser rated. Color shall be blue. Minimum spec cable is unacceptable and will be rejected.
b. Approved Manufacturers:

1) Berk-Tek – Lanmark 1000
2) Belden/CDT – 3600 series
3) Mohawk – Advance Net
4) General – Genspeed 6000
5) Panduit – PanGen 6 Enhanced
6) Superior/Essex – DataGain Cat 6+
7) Hitachi – Premium Series
8) Commscope - Ultramedia 7504

2. Category 6 Patch Cables:

a. Category 6 compliant per TIA 568-C.
b. Compliant per TIA-568-C and TIA/EIA-606-A for cable management and administration.
c. Each patch cable shall be bootless.
d. Patch cables shall be color coded as follows:

1) Telecommunications Closet Patch Cables:

a) Data Ports: Blue.

e. Patch cables within the equipment closets shall be a minimum of one foot (1') in length and have a maximum of two feet (2') access coil length to avoid excess cable in the rack. The contractor shall install the cable to provide neat and organized patches to equipment. The contractor is required to review site conditions to ensure the proper cable lengths are installed in all District buildings.
f. Approved Manufacturers:

1) Berk-Tek – Lanmark 1000

2) Belden/CDT – 3600 series
3) Mohawk – Advance Net
4) General – Genspeed 6000
5) Panduit – PanGen 6 Enhanced
6) Superior/Essex – DataGain Cat 6+
7) Hitachi – Premium Series
8) Commscope - Ultramedia 7504

3. Media Outlets and Connectors

a. Unshielded Twisted Pair media outlet terminations shall conform to the following:

1) Eight (8) position, eight (8) conductor modular plug, certified Category 6, T568B plug pin assignment. Modular Category 6 plug will be a five (5) piece connector with an integral plug housing, load bar, divider, strain relief boot and collar. Category 6 modular plugs will be specifically designed for use in conjunction with 22-24 AWG solid conductor unshielded twisted pair cabling. All Horizontal data cable will be terminated with a Category 6 modular plug to mate directly to the projector.

OR

2) Eight (8) position, eight (8) conductor, 110 IDS, modular snap-in jacks, certified Category 6, T568 jack pin assignment.
3) Data only faceplates shall be stainless steel of a size to accommodate the raceway and gang boxes identified on drawings with adequate punch-outs for appropriate snap-in jacks.
4) Faceplates that contain both A/V and data connections shall be provided by the A/V Contractor. This Contractor shall provide data connectors for the shared faceplate.
5) Approved Manufacturers:

a) Hubbell
b) Uniprise
c) Leviton
d) ICC
e) Superior Modular
f) AMP
g) Ortronics
h) Panduit
i) Engineer approved equal

4. Telecommunication Room Termination Hardware:

a. Horizontal Category 6 cables shall be terminated in the telecommunication room on existing rack mounted, 24-port or 48-port patch panels with 110 style termination block, certified Category 6. Refer to Drawings for exact locations.

1) Patch panels shall have a rear mounted strain relief bar to organize cables and maintain Category 6 bend radius.
2) Category 6 compliant per TIA 568-C.
3) Compliant per TIA-568-C and TIA/EIA-606-A for cable management and administration.
4) 1U and 2U horizontal wire managers. Refer to Drawings for exact locations.
5) Approved Manufacturers:

a) Hubbell
b) Uniprise
c) Leviton
d) ICC
e) Superior Modular

f) AMP
g) Ortronics
h) Panduit
i) Engineer approved equal

PART 3 - EXECUTION

3.1 GENERAL

A. Recognizing school and community events occur during the day or evenings, network outages shall be minimized and coordinated with the Owner's operations.

B. All cables must be routed and managed for a neat and aesthetically pleasing appearance. All work must be installed in a neat and workman like manner.

C. Install patch cables in a professional manner. Utilize existing wire management where applicable. Where wire management is not available, provide wire management, route patches neatly in such a way to protect the patch cables from damage. Utilize Velcro tie wraps as needed. Plastic tie wraps are not acceptable and will be rejected.

D. Communication bonding and grounding shall be in accordance with the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.

E. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus unless the conduit, channel or sleeve is divided and manufactured specifically for the purpose of cohabitation. Maintain separation as follows:

1. 5' for large motors and transformers
2. 1' for conduit and cables used for electrical power distribution
3. 6" for fluorescent lights

F. The Contractor shall provide any necessary screws, anchors, clamps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the system.

G. It shall be the responsibility of the contractor to furnish any special installation equipment or tools necessary to properly complete the system.

H. Remove ceiling tiles as required to accommodate new work under this Contract. Notify Owner of any damaged tiles prior to removal. Tiles damaged during construction shall be replaced by this Contractor.

3.2 PRE-INSTALLATION SITE SURVEY

A. Prior to start of systems installation, meet at the project site with the owner's representative and Technology Designer/Engineer to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

C. The school's buildings consist of primarily lay-in ceilings with hard ceilings in typical spaces such as locker rooms and toilet rooms. It is the contractor's responsibility to visit the sites and include all access doors, conduit and any other miscellaneous equipment necessary for a neat, complete and professional installation.

3.3 INSTALLATION – DATA WIRING

A. Provide, install, test and tag one (1) Category 6 data drop as indicated on the drawings.

B. Installation practices shall follow BICSI standards and guidelines. TIA/EIA-568-C standards will be strictly followed and practiced.

C. All cabling in equipment cabinets/racks shall be managed utilizing existing and new wire organizers provided by the Contractor. All cabling and patch cables in closets shall be secured using velcro straps.

D. Category 6 cables shall be continuous from telecommunications room to work area outlet and free from splices, reverses, grounds or other connections. Provide a minimum 10-foot service loop or follow existing service loop within telecommunications closet, whichever is greater. Service loop shall be neatly coiled and secured above accessible ceiling, for each terminated cable, to accommodate future changes.

E. Terminate Category 6 cable according to T568B jack pin assignments.

1. Remove only the amount of cable jacket necessary for termination. Maintain wire twist for all pairs of Category 6 cable to within 0.5 inches maximum from termination point.

F. Do not run cable longer than maximum 90 meter EIA/TIA recommended length.

G. All cables installed in ceiling spaces shall be plenum-rated.

H. Horizontal data cable pairs shall run from each work area outlet to the telecommunications room and terminate on Category 6 patch panels as appropriate.

I. All cables shall be installed using “J” hooks, conduits, cable tray or an approved raceway system. Where cable tray is not available, horizontal cable will be supported every five feet with “J” hooks sufficient in size to handle all bundled cables while minimizing crushing. If cable slack exceeds twelve (12) inches between supports, additional supports will be installed to take up slack and relieve cable stress.

J. The use of “bridle rings” is strictly prohibited.

K. Carefully lay all cable with appropriate radius of curvature and protect at bends and corners. Observe minimum bend radius and tension limitations as specified by EIA/TIA for Category 6 cable.

L. Loosely bundle cables with plastic tie wraps, suitable for Plenum environments, every twenty feet.

M. Patch panels shall be arranged to allow for natural wiring progression in functional fields, minimize crossing of wires and allow for the easy access to each component.

N. The contractor shall assure that at the completion of cable installation, cables are free from twists, kinks, sharp bends, cuts, gouges or any other physical damage that might cause alterations to the electrical or optical characteristics of the cables.

O. Installation of new communications cabling through existing cable bundles is strictly prohibited to minimize cable burning.

3.4 LABELING

A. All cable designations and color-coding shall be in full compliance with EIA/TIA 606-A.

B. Clearly label all horizontal copper and fiber cables at both ends with permanently applied mechanically printed labels. Hand written labels will not be acceptable. Use standardized colors and alphanumeric codes. Technology Designer/Engineer will approve labeling system and method.

C. In work areas, place cable ID labels around each cable in outlet box, on front of faceplate.

D. In the telecommunications room or at wireless access points, place ID labels around each cable. Labels shall be located within six inches of the termination.

E. Front label each patch panel port with a mechanically produced identification label utilizing the Owner's existing labeling scheme.

F. Label each faceplate and cable mated directly to equipment with a mechanically produced identification label utilizing the Owner’s existing label scheme.

3.5 CATEGORY 6 UTP CABLE TESTING

A. The Contractor shall, at all times, permit and facilitate work inspection by the Owner’s Representative and by public authorities having jurisdiction. The Owner’s Representative shall have the authority to stop the work, if required, to insure proper execution.

B. Each Category 6 UTP cable pair shall be tested end to end from the data outlet termination to the closet patch panel.

C. Test shall be performed with connectors installed.

D. Cable performance shall meet the standards outlined in EIA/TIA-568-C for Category 6 cabling.

E. Tone, verify and certify cable and jack/connectors as free from shorted pairs, open pairs, reversed pairs, crossed pairs and grounded pairs. One hundred percent of all pairs must be in good working condition.

F. Check cable length and labeling at both ends.

G. Cables and connectors comprising of Category 6 must be certified compliant with the performance requirements listed in TIA-568-C.

1. As a minimum, test documentation will include:

a. Cable Identification Number
b. Worst Case Near End Cross Talk (NEXT)
c. Attenuation
d. PSNEXT
e. Return Loss
f. PSELFEXT
g. Signal-to-Noise Ratio
h. Ambient Noise
i. Loop Resistance
j. Equal Level Far-End Crosstalk (EL-FEXT)
k. Return Loss
l. Propagation Delay
m. Propagation Delay Skew
n. Cable Length
o. Test Date

2. Each data circuit, including all connectors shall be tested to verify all bandwidth performance and crosstalk specifications as outlined for Category 6 cable. Any cables not in one hundred percent compliance with the minimum performance criteria relating to these requirements will be replaced with no additional cost to Owner.

H. Cable testing will be conducted by a programmable micro-computer based tester capable of testing all specific standard requirements and generating completed printed test results.

1. Test equipment shall be a Fluke, or approved equivalent. Equipment will be designed, and of such grade, so as to provide reliable certification and testing.

I. A detailed copy of all test reports shall be provided to the Owner in CD format. Additionally, the Contractor shall provide hardcopy documentation indicating cable length and the pass test results for each Category 6 cable installed.

J. Any outlet, cable or component that does not meet the required operational tests or fails to meet installation standards as specified shall be repaired or replaced and re-tested by the Contractor as directed by the Owner and at no expense to the Owner.

3.6 PROJECT RECORD DOCUMENTS

A. Fully detailed documentation and record drawings of installation layout and performance shall be submitted for review within thirty (30) days of completion of work and shall include as a minimum:

1. Marked drawings showing distance and routing of all inside cable with gauge, type and numbering scheme.
2. Location of outlets with their identification number prepared on the most recent installation drawing.
3. Drawings showing distribution frame layouts, cross connect locations, cable routing from rooms.
4. Drawings showing layout of panels and equipment in cabinets.
5. Drawings shall accurately record actual locations of each item of fixed equipment and show interconnecting wiring. Drawings will indicate location of equipment and tagged circuits. A functional block diagram will also be required.
6. On electronic drawings, provide data cabling on a separate layer from the architectural layer so the Owner can turn the data layer on and off.

B. Documentation Requirements:

1. Drawings, whenever submitted, shall be submitted with three (3) copies to the Owner.
2. Cable and outlet identification, locations, performance and test results will be entered into Excel or approved PC based spreadsheet. The Contractor spreadsheet template and format will be approved by the Owner.
3. Final record drawings shall be submitted as three (3) sets of scaled 20# bond drawings and two (2) CD-ROM's containing both PDF and AutoCAD LT 2004 formats. Drawings shall be professionally done with architectural floor plan on one layer and all technology equipment and cabling on a second layer. Hand drawings and notations will not be accepted.

C. Cable Record Book:

1. The Contractor shall prepare and deliver complete and accurate cable records entered into Excel or approved PC based spreadsheet. Minimum information to be included for each cable in the Cable Record Book is:

a. Location (room number)
b. Jack Number
c. Serving Closet
d. Patch Panel Number
e. Patch Panel Port
f. Cable Type and Use (Cat 6, voice)

D. All drawings and the information contained therein become the sole property of the Owner.

END OF SECTION 27 1000

SECTION 27 4100 – AUDIO VIDEO SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Bidding Documents, including the Division 01 Specification Section, apply to work of this Section.

1.2 SUMMARY OF WORK

A. This Specification, in conjunction with the Drawings, establishes the requirements necessary to achieve the intended performance and function of the AV Systems.

B. This section includes the following:

1. Audio systems
2. Video systems
3. Control systems
4. Accessories

1.3 SYSTEM DESCRIPTION

A. Base Bid Scope Includes the following:

1. AV systems in the Executive Boardroom, lobby and breakroom as shown on electrical floor plans, and within the functional diagrams.
2. All required power and conduit for each system shall be provided and installed by the electrical contractor, unless otherwise noted.

1.4 SPARE PARTS

A. None.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. All material or equipment specified is referenced on electrical drawings on both floor plans and functional diagrams.

B. **No substitutions without approval.**

2.2 CABLES AND WIRING

A. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper.

B. Cable shall carry appropriate fire rating (e.g. CL2, CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.

C. Must provide a minimum of 3’ service loop for rack clearance.

D. Where cables are routed through cable tray, provide tray rated cable of equal gauge.

E. Where cables are run exposed through a return air plenum, provide plenum rated cable of equal gauge and performance.

F. Shielded cables located in raceways shall have aluminum foil shield with drain wire.

G. Cables from Belden, Commscope, Gepco, and West Penn are acceptable.

1. Use the color green whenever possible for all AV cabling.

2.3 SUBSTITUTION OF SPECIFIED EQUIPMENT

A. The following lists of equipment are provided to identify the products that are to be supplied by the bidder. These lists provide manufacture, model number and description of equipment to be provided and installed. Some items are noted that indicate if the items can be substituted or not. If a substitution is allowed the contractor must secure permission to substitute the equipment.
1. Substitution Legend:

1 = No substitutions allowed. Provide equipment item as listed.
2 = Item specified is the basis of design and is preferred over other products. Substitution is allowed with equipment that is an approved equal or better than what is specified.
3 = Substitution allowed but must meet product quality and specification of item listed.

2.4 AV SYSTEM COMPONENTS

A. The various AV systems at Frankenmuth Insurance shall be provided and installed with the following list of equipment, all equipment listed shall include complete installation and setup for a turn-key project. See all drawings as part of this project for diagrammatic design intent, quantities of each product, and locations of equipment in various locations.

Item	Manufacturer	Model Number	Description	Substitution Legend
1	Clock Audio	CDT 100	Dante Control unit with (4) microphone inputs	1
2	Clock Audio	CS 1S-RF RGB	Table Microphone	1
3	QSC	Core 8 Flex	Audio Processor with Dante	1
4	QSC	CX302V	2-channel Amplifier	2
5	Crestron	CEN-SW-POE-5	5-port PoE switch	2
6	Crestron	TSW-770	7” Touch Screen Controller with RJ45	1
7	Crestron	DM-TX-200-C-2G	DM wall plate transmitter with USB, 3.5mm aux and HDMI input. DM output	1
8	ATS-PRO	Thin LED	Quote Number 500	2
9	Denon	DN-200BD	Blu-Ray Player with RS-232 control and (1) HDMI out	2
10	Crestron	DMPS-4K-350	DM Switcher with (2) DM inputs and (2) DM outputs, (4) HDMI inputs and (2) HDMI outputs, (4) relay outputs	1
11	LG	55UT640S0UA	55” TV and provide fixed mount	2
12	LG	65UT640S0Ua	65” TV and provide fixed mount	2
13	JBL	Control 26 CT	6.5” speaker with 100 degree conical coverage	2

PART 3 - EXECUTION

3.1 MATERIAL AND WORKMANSHIP

A. Material, workmanship, wire, and wiring methods shall be performed as specified.

B. If, in the opinion of the Installing Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the Technology Designer and Owner. Modifications shall not be implemented without the written approval.

C. All materials and labor shall be furnished whether mentioned or not to form a complete system operational as per the intentions and description set forth in Part 1. Include delivery, unloading, placement, fastening to walls, floors, ceiling, counters, or other structures where required, interconnecting wiring of the system components, and all other work and materials necessary to form a complete operational system.

3.2 SYSTEM PROGRAMMING

A. Programming:

1. Meet with the owner and IT consultant (architect/engineer) to set up all system programming prior to any development of software operation. No allowances will be made for failure to get complete acceptance of system operation prior to the software development.
2. The technology contractor shall have a "Certified Crestron Programmer" on staff or the contractor's programmer must hast have at least 10 years' experience of Crestron programming. Must provide resume of systems of this type. The technology contractor shall provide a copy of the certificate bearing the name of the programmer. If the technology contractor does not have a "Certified Crestron Programmer" on staff, that technology contractor shall contract a CAIP (Crestron Authorized Independent Programmer) and provide the name of the CAIP. If using a CAIP programmer, the technology contractor will be legally bound to complete the installation with acknowledged CAIP.
3. Documentation of the technology contractor's Certified Crestron Programmer's continuing education should also be submitted if that member has attended Crestron's annual training for Certified Crestron Programmers.
4. The technology contractor shall provide for owner use a final revision of the touch panel control system in an X-Panel configuration. The x-panel software will be utilized by the tech support staff for remote control of the control system.
5. Exceptions shall not be granted to the Crestron certification requirements identified above. A letter from Crestron indicating training has been taken but that a certificate has not been granted is insufficient and is cause for bid non-compliance.
6. The programming of all media control system shall be efficient and clear without unnecessary content as to allow a seamless integration keeping any latency in device response at a complete minimum.
7. Programming for the graphical user interface (GUI) shall conform to the owner's standards. The contractor shall provide provisions to accommodate revisions, as necessary, to the system and GUI related to this project. This contractor shall plan on revision coordination meetings, including operational changes and GUI changes, of no less than three (3) occurrences per building. Crestron programming development for this project shall be well organized and planned by this contractor. The duration of the available revision shall follow the requirement of the system warranty. Any and all programming development shall not be put into effect without the express consent of the owner.
8. For purposes of review and approval of the GUI, this contractor shall generate a standalone executable emulator file, which will be sent to the owner and architect for evaluation, with the ability to be run on a PC in order to simulate actual GUI operation.
9. This contractor will utilize Crestron integrated partner modules, wherever possible, for advanced programming needs. Template development and customization shall be approved by the owner prior to final implementation.
10. Upon successful completion of the installation, a copy of all un-compiled source code, for the control system(s), shall be provided to the owner. Code for any/all rooms shall be provided. Further, it shall be understood, by this contractor, that all programming development as part of this project is the property of the owner. Failure to acknowledge this shall be considered grounds for bid non-compliance.
11. Programming for Crestron Mobile is required. All compatible devices should be able to mimic the touch panels in the room they are controlling.
12. Integrate all Crestron and compatible devices to existing Crestron Fusion for remote monitoring, scheduling and control.
13. The Contractor shall deliver a copy of the un-compiled Crestron source code, for the control system(s), to the Construction Manager. Code for any/all rooms shall be provided and is the sole property of the Owner. This shall be completed at the close-out of the project.

3.3 LABELING AND INVENTORY

A. Provide a Microsoft Excel equipment inventory spreadsheet containing the following information for all equipment installed under this contract:

1. Install date
2. Equipment description
3. Manufacturer model number
4. Manufacturer serial number

3.4 INSTALLATION – AUDIO/VIDEO SYSTEMS CABLING

A. The contractor shall ring out and identify, with sturdy tie-wraps clearly marking every cable in the system (both ends). All markings shall include purpose destination and origination of the wire or cable.

B. The Contractor shall loosely bundle cables with Velcro wraps, suitable for Plenum environments, every twenty (20) feet.

C. The Contractor shall not fasten supports to pipes, ducts, mechanical equipment, conduit or metal deck roof.

D. The Contractor shall obtain permission from the Owner before drilling or cutting structural members.

E. Powder actuated anchoring devices shall not be used to anchor any cable support or raceway system components.

F. It shall be the responsibility of this contractor to provide open top cable supports, i.e. “J” hooks, in the ceiling space for cable support. AV cable supports shall be separate and distinct from all other low voltage system cable supports (i.e. security, alarm, voice and data, etc.).

G. Cabling shall be run parallel and perpendicular to building walls.

H. All cabling installed in ceiling spaces shall be plenum rated.

I. Communication bonding and grounding shall be in accordance with the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.

J. The contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

K. The contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the system.

L. It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the system. This may include, but is not limited to, scaffolding and hydraulic lifts.

M. All cables shall be installed in conduits and raceways or an Engineer approved raceway system. Where conduits do not exist, provide “J” hooks sized appropriately for the bundle.

N. Remove only the amount of cable jacket necessary for termination.

O. Carefully lay all cable with appropriate radius of curvature and protect at bends and corners. Observe minimum bend radius and tension limitations as specified by EIA/TIA.

P. All cables must be routed and managed for a neat and aesthetically pleasing appearance. All work must be installed in a neat and workman like manner.

Q. Bundled cables shall be secured with plenum rated Velcro© ties. Zip ties will not be permitted.

R. The contractor shall assure that at the completion of cable installation, cables are free from twists, kinks, sharp bends, cuts, gouges or any other physical damage that might cause alterations to the electrical or optical characteristics of the cables.

S. The contractor shall work carefully with all ceilings and return ceilings to original conditions. Any damages or expenses are the responsibility of the contractor.

T. The contractor shall use standard cable practices in the installation of the audio/video system.

U. All equipment needing to be operated from the front panel will be rack mounted.

V. Terminal block, boards, strips, or connectors shall be furnished for all cables, which interface with racks, cabinets, consoles, or equipment modules.

W. All cables shall be grouped according to the signals being carried in order to reduce signal cross-talk. Separate groups shall be formed for the following cables:

1. Group one: Power Cables
2. Group two: Video Cables
3. Group three: Microphone level audio cables
4. Group four: Line level audio cables
5. Group five: Speaker level audio cables

X. Power cables, control cables, and high level cables shall be run on the left side of an equipment rack, as viewed from the rear. All other cables shall be run on the right side of the equipment rack, as viewed from the rear.

Y. Cabling within racks shall be contained in Panduit finger tray or wire-tied to the side of the rack in a neat and orderly fashion. Such cables shall remain separated as indicated in section G above.

Z. All cables routed outside of racks and conduit shall be contained in a suitable harness or wireway to maintain a neat, clean, and finished product.

AA. Supply all jacks, racks, wire, cabinetry, connectors, materials, parts, equipment and labor necessary for the complete installation of the systems, in full accordance with the recommendations of the equipment manufacturers and with the requirements of the Specifications and Drawings.

BB. All installation shall follow broadcast wiring and installation practice, with particular note given to installation instructions given in the equipment section of these Specifications.

CC. Observe proper circuit polarity and loudspeaker wiring polarity. Properly and clearly label all connections and wires as to function and polarity.

DD. No cables shall be wired with a polarity reversal between connections, at either end.

EE. All cables shall be continuous lengths without splices. All system wire, except spare wire, after being cut and stripped, shall have the wire strand twisted back to their original lay and be terminated by approved soldered or mechanical means.

FF. Clearly and permanently label all racks, controls, connections, and so forth, with engraved laminated plastic labels. Do not use embossed or printed label tape. Attach labels with contact cement. All labeling shall be completed prior to final system equalization.

GG. All equipment shall be held firmly in place with proper types of mounting hardware. All equipment shall be installed to provide reasonable safety to the operator. Supply adequate ventilation for all enclosed equipment items, which produce heat.

3.5 GROUNDING PROCEDURES

A. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding procedures shall be adhered to:

1. Under no circumstances shall the racks contact the conduit raceway system, the steel structure of the building, or ventilation ducts.
2. Under no conditions shall the AC neutral conductor, at any location, be used for a system ground.
3. Audio Cable Shields: All audio cable shields shall be grounded at one point only. There shall be no exceptions. For inter- and intra-rack wiring this requires that the shield be connected at the one end only. On un-grounded portable equipment, such as microphones, the shield shall be connected at both ends but grounded at one end only.

B. There shall be no deviations from the above unless specifically required by the manufacturer of the equipment or when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.

C. If a different installation practice is desired by the Installing Contractor in regard to the signal grounding, the Installing Contractor may submit alternate grounding methods to the Construction Manager for approval. Installing contractor shall bear all responsibility for any deviations from the above stated grounding procedure, even if allowed by the Consultant, Owner, or Architect.

3.6 CONTRACTOR SYSTEM CHECKOUT

A. Before final testing is scheduled, the Contractor shall perform his own systems checkout. He shall furnish all required test equipment and shall perform all work necessary to determine and/or modify performance of the system to meet the requirements of these specifications and drawings. This work shall include the following, where applicable:

1. Testing of all Microphone inputs and Tie-lines
2. Testing of all Speaker Lines and Jacks
3. Testing of any other wires or components
4. Test all Audio and Video for compliance with the Performance Standards.
5. Check all control functions for specified operation.
6. Align all equipment for optimum performance and to meet manufacturers' published specifications.

3.7 SYSTEM PERFORMANCE, TESTS AND ADJUSTMENTS

A. Testing Personnel: The Installing Contractor shall have a minimum of two persons knowledgeable as to the systems as installed available for testing and adjustment with the Consultant.

1. All costs to the Installing Contractor for testing personnel shall be included in the bid.
2. Installing Contractor shall allow for a minimum of eight (8) hours of testing and adjustments with the Consultant.
3. Failure of the Installing Contractor to provide adequate personnel or testing equipment causing lost time to the Consultant shall result in the Installing Contractor paying the Consultant's standard hourly rate for additional time and expenses as necessary.

B. Test Equipment:

1. All equipment for testing and adjustments to the sound system shall be furnished by the Installing Contractor. Test equipment shall include:

a. Computer Measurement Platform: SMAART, TEF, SIM or other approved equal

b. Dual Trace Oscilloscope
c. High Quality Multi-meter: Fluke or Similar
d. Sweepable Tone Generator

2. The Consultant may choose to bring and use some of his own test equipment.
3. Furnish make, model, and serial number of all test equipment to be used to the Consultant prior to performing any test and adjustments to the system.

C. Loudspeaker Impedances: Measure and record the impedance of each loudspeaker line. For high frequency drivers take impedance measurement at 4000 Hz. For mid-range drivers take impedance measurement at 1000 Hz. For low frequency drivers take impedance measurements at 100 Hz. An impedance sweep may also be performed using TEF, SMAART, or other approved equal. Results of all impedance tests shall be recorded and furnished to the owner for future system repair and trouble-shooting.

D. Noise and RF Pickup:

1. Set up system for each specified mode of operation.
2. Check to ensure that system is free of noise, hum, and radio frequency interference.

E. Hum, Buzzes, Rattles, Distortion:

1. Apply high-quality music signal to the system. Adjust the system for frequent peaks at its specified maximum sound pressure level.
2. Apply sine-wave sweep from 50 to 5,000 Hz at 10 dB below full amplifier power.
3. In both cases, listen carefully for buzzes, rattles and objectionable distortion.
4. Correct all causes of such defects. If cause is outside system, promptly notify the Owner indicating cause and suggested corrective procedures.

F. Equalization:

1. Prior to system commissioning furnish names of personnel involved in project management, final adjustment, and tuning. Furnish a profile of experience and training of the personnel completing the tuning.
2. Final equalization and setup shall be done under the supervision of the Consultant. As described in the above sections.

G. SPL Recording:

1. Measure the SPL at a minimum of eight points within the space to confirm that coverage at octave band center frequencies from 63 Hz to 8000Hz is a maximum of +/- 3dB.

3.8 FINAL TESTING AND EQUALIZATION

A. The testing work shall be performed after the installation work has been completed, but prior to ANY use of the system. During the testing work, the installer shall have on the job, one competent technician who is familiar with the project, and who shall be prepared to stay as long as his/her services are needed.

B. Prior to the testing, the installer shall insure that the system is free of short circuits, ground loops, parasitic oscillations, and excessive system noise beyond published specifications of the equipment.

C. The Installing Contractor, at the Installing Contractor's expense, shall rectify any components not found to function in a satisfactory manner as defined by this specification.

D. The Final Testing shall be made in the presence of the Owner or Owner's Authorized Representative.

3.9 AS-BUILT DRAWINGS AND DOCUMENTATION

A. All tuning and adjustment shall have hard copy data bound and turned over to the Engineer and Consultant. Submit record drawings and Documentation of Tests, Measurements and Adjustments performed. All submittals shall be furnished before final payment is released.

B. A copy of all DSP settings shall be burned to CD and placed in the rack after the completion and acceptance of all work and testing.

C. The original submittal drawings shall be corrected for record purposes and show all changes and addition.

D. Fully detailed documentation and record drawings of installation layout and performance shall be submitted for review within thirty (30) days of completion of work and shall include as a minimum:

1. Marked drawings showing distance and routing of all inside cable with gauge, type and numbering scheme.
2. Location of outlets with their identification number prepared on most recent installation drawing.
3. Drawings showing distribution frame layouts, cable routing from rooms.
4. Drawings showing layout of panels and equipment in cabinets.
5. Drawings shall accurately record actual locations of each item of fixed equipment and show interconnecting wiring. Drawings will indicate location of equipment and tagged circuits. A functional block diagram will also be required.

E. Documentation Requirements:

1. Drawings, whenever submitted, shall be submitted with three (3) copies to the Owner.
2. Cable and outlet identification, locations, performance, and test results will be entered into Excel or approved PC based spreadsheet. The Contractor spreadsheet template and format will be approved by the Owner.
3. Final record drawings shall be submitted as one (1) ANSI C laminated drawing, two (2) sets of scaled 20# bond drawings and two (2) CD-ROM in PDF format. Drawings shall be professionally done. Hand drawings and notations will not be accepted.

F. All drawings and the information contained therein become the sole property of the Owner.

3.10 FINAL INSPECTION

A. The Installing Contractor, at the Installing Contractor's expense, shall rectify any components not found to function in a satisfactory manner as defined by this specification.

END OF SECTION 27 4100

SECTION 28 3111 - FIRE ALARM SYSTEM - ADDRESSABLE

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 work of this section.

1.2 SUMMARY

A. This Specification provides the requirements for the modification of a point-addressable type manual and automatic fire detection system network. Modifications to the existing fire alarm system shall include the reconfiguration of alarm notification devices as required to accommodate the renovation of the Media Center suite, and all programming required to incorporate new devices\layout. Provide all necessary system components (expansion cards, NAC panels, wiring, etc.) to expand the existing system and provide a complete code compliant operational system.

B. The completed system shall be certified on State Fire Marshal Form FM-12A in accordance with Public Act 144.

1.3 FIRE ALARM AND PROTECTIVE SYSTEM SEQUENCE OF OPERATION

A. The operation of a manual station or activation of any area smoke detector, duct smoke detector, thermal detector, sprinkler water flow switch, or any automatic alarm initiation device shall automatically:

1. Sound all alarm signals (Code 3) throughout the building.
2. Flash all alarm lights/strobe throughout the building. Silencing the devices (audible circuit) shall not automatically turn off flashing alarm lamp/strobes.
3. Operate prioritized outputs to release all smoke doors and magnetically-locked doors throughout the building.
4. Initiate the transmission of an alarm to central stations selected by the Owner or his representative. This selection, its fees and fees for any telephone lines are the sole responsibility of the Owner or his representative.
5. Visually indicate via the control panel LCD or an alarm LED, the addressable device of the circuit of alarm initiation. When the control panel goes into the alarm condition the (GREEN) NORMAL LED shall extinguish and the (RED) ALARM LED shall light, the BUZZER shall pulsate and the first line of the 80 character LCD shall indicate the REAL TIME, the number of MESSAGES WAITING< the TYPE OF ALARM, the ALARM ZONE NUMBER, and the TIME THAT THE ALARM OCCURRED>. The second line shall display the user specified message. In order to reduce false alarms, all inputs shall be capable of alarm verification. The system shall be capable of setting the sensitivity of all analog sensors by point and be capable of displaying the analog value of the sensor by device and/or traditional input and vectoring the value to the printer. The system shall automatically identify any analog sensor which becomes dirty (maintenance alert) prior to false alarming.
6. Upon operation of the associated duct smoke detector, the air handling systems shall be deactivated so as to prevent the recirculation of smoke. Such actions shall override the regular mechanical systems controls.
7. All smoke detector circuits shall be provided with alarm verification with adjustable time from 0 to 60 seconds. Time to set at 10 seconds.
8. A break in the initiating loop wiring shall light both the common trouble lamp and the respective zone trouble lamp on the control unit, as well as sound a trouble signal at the fire alarm control panel.
9. A break in the indicating loop wiring shall light the common trouble LED and "Indicating Loop Trouble" LED on the fire alarm control unit, as well as sound a trouble signal at the fire alarm control unit.

B. The operator shall acknowledge the alarm by pressing the acknowledge button, and the buzzer will silence providing there is not an additional alarm pending. If there are additional alarms waiting, the operator shall acknowledge all pending alarms before the buzzer will silence. To silence audible devices, the operator shall press the ALARM SILENCE button, a new alarm shall cause the audibles to resound. To reset the system, the operator shall press the RESET button.

C. Activation of a supervisory condition such as a sprinkler valve tamper switch, etc. shall automatically:

1. Display on the control panel LCD the zone or the addressable device from which the off normal (active point) condition was initiated. During the SUPERVISORY condition the amber SUPERVISORY LED shall light, the NORMAL LED shall go out, and the BUZZER shall pulsate. The LCD shall indicate ("SUPERV. SHORT") and the zone/ device number. The operator shall silence the buzzer by acknowledging all messages and pressing the TROUBLE SILENCE button.
2. Operate the prioritized output to initiate transmission to the central station.
3. Supervisory alarms shall be differentiated from trouble condition on circuit.

1.4 STANDARDS

A. The equipment and install shall comply with the current provisions of the following standard:

1. National Electric Code, Article 760 and applicable standards of NFPA 90A including (not an inclusive list):

   a. NFPA 72A National Fire Alarm Code.
   b. NFPA 101 Life Safety Code.

2. Local and State building codes.
3. Local authorities having jurisdiction: ULC, CSFM, BSA, State Fire Marshal.
4. Underwriters' Laboratories, Inc.

B. The system and all components shall be listed by Underwriters' Laboratories, Inc. for use in fire protective signaling system under the following standards as applicable:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems".
2. UL 217, "Single and Multiple Station Smoke Detectors".
3. UL 268, "Smoke Detectors for Fire Protective Signaling Systems".
4. UL 268A, "Smoke Detectors for Duct Applications".
5. UL 464, "Audible Signal Appliances".
6. UL 521, "Heat Detectors for Fire Protective Signaling Systems".
7. UL 864, "Control Units for Fire Protective Signaling Systems"
8. UL 1480, "Speakers for Fire Protective Signaling Systems".
9. UL 1971, "Signaling Devices for the Hearing Impaired".

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

1. Shop Drawings: Submit detailed point-to-point wiring diagrams and installation instructions. Shop drawings shall show color coding of connections and mounting dimensions of equipment.
2. Product Data: Submit product data for each fire alarm system component specified.

B. A complete set of shop drawings shall be submitted to the State of Michigan (SOM) Office of Fire Safety for approval in accordance with Act 144 of 1982. Shop drawings shall be approved by the SOM and all SOM comments reflected on the documents prior to submission of the shop drawings to the Engineer for approval. Shop drawings submitted to the Engineer prior to SOM approval will be returned - rejected.

C. The Contractor shall submit complete sets of documentation within 30 calendar days after award of purchase order. Indicate the type, size, rating, style, catalog number, manufacturers' names, photos, and/or catalog data sheets for all items to ensure compliance with these Specifications. This equipment shall be subject to his approval and no equipment shall be ordered without this approval. Equipment devices are shown on the Contract Drawings, provide shop drawings as follows:

1. Complete one-line riser diagram showing all equipment and the size, type and number of all conductors.
2. Drawing of typically multiplexed field panel.
3. Provide calculations to support the size of standby batteries submitted.
4. Include programming and installation manuals.

D. At Contract close-out deliver six (6) copies of the following to the Owner's Representative within thirty (30) days of date of system acceptance:

1. Installation and programming manuals covering the installed system.
2. Point-to-point diagrams of the entire system as installed. Number all conductors and show all terminations and splices.
3. The application program listing for the system as installed at the time of acceptance.
4. Name, address, and telephone of the authorized factory representative.

1.6 WARRANTY

A. Warranty all materials, installation and workmanship for one (1) years from date of acceptance, unless otherwise specified.

1.7 MAINTENANCE

A. Maintenance and Service Contract: Submit a maintenance and service contract with service rates covering all labor and materials necessary to repair damages to the system. The service contract shall include a differentiation between and definitions of "emergency" and "non-emergency" service with applicable rates for each.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Provide products by one of the following:

1. National Time & Signal Corporation

2.2 NODE AND NAC PANELS

A. Node and NAC panels shall be modular with solid state, microprocessor based electronics, operator interfaces, power supplies, audio generators, amplifiers, battery chargers and batteries as required. All components shall be supervised.

2.3 BATTERIES

A. Batteries shall be lead calcium and supervised so that a failure produces a "TROUBLE" signal.

2.4 MONITOR MODULES

A. Monitor modules for individual two wire contact monitoring shall be individually addressable, suitable for two wire operation, with a DIP switch or electronic addressing means, and a programmable latch feature for monitoring momentary contacts. Monitor modules shall monitor a single normally open dry contact using a Class B, Style B, initiating device circuit.

2.5 CONTROL MODULES

A. Control modules shall be individually addressable with DIP switches or electronic addressing means. Control modules shall provide either one normally open and one normally closed contact or a Form C contact per digital output. Control modules may have more than one digital output per module if each output has a unique address. Contacts shall be rated 0.5 amps at 120 volts AC or 2 amps at 28 volts DC resistive and shall be controlled by the panel.

2.6 SPEAKERS

A. Speakers shall be rated 125 to 12,000 Hertz, include four taps rated at from 1/4 to 2 watts, produce a sound level of 82 dBA at 10 feet when set at the 1/2 watt tap, and with a semi-flush body capable of wall or ceiling mounting..

B. Speakers for locations with high ambient noise may be high efficiency horns rated 500 to 6,000 Hertz minimum, 10 watts minimum, include four or more taps, produce a sound level of 106 dBA minimum at 1 meter when set at the 1 watt tap, and be capable of wall or ceiling mounting.

2.7 STROBES

A. Strobes shall be rated 15, 30, 60, 75, 110 or 177 candela as shown for proper illuminance, with a 1 Hertz flash rate, Xenon flash tube, white body, clear Lexan lens with red "FIRE" or international fire symbol lettering, capable of being synchronized, and capable of wall or ceiling mounting.

2.8 COMBINATION HORN/STROBES AND SPEAKER/STROBES

A. Combination horn/strobes and speaker/strobes shall consist of the horns, speakers and strobes specified above, but combined on a single mounting plate. Combination units used outdoors and in wet areas shall be waterproof and mounted to waterproof back boxes.

2.9 WIRE AND CABLE

A. Wire and cable shall conform to the applicable provisions of Section 26 0519 “Low Voltage Electrical Power Conductors and Cables (0-600V)”.

B. All fire alarm cable shall be plenum-rated with red insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. System shall be installed with dedicated conduits, raceways, conductors, outlet boxes, fittings, connectors and accessories necessary to ensure a complete, operable system in compliance with all applicable codes and regulations.

B. Install all equipment at locations indicated, and secure to ceilings, walls, floors or structural members as required.

C. Install all wiring in conduit or raceway systems as indicated and as specified in Section 26 0533, except above lay-in ceilings. J-hooks or D-rings may be used above lay-in ceilings.

D. Install wiring in low profile surface metal raceway in offices, classrooms and similarly “finished areas” in lieu of conduit where conduit cannot be concealed.

E. Provide final wiring and connections per the manufacturer's wiring diagrams. Wiring for the fire alarm system shall be in separate conduits from any other system.

F. Outlet, pull and junction boxes shall be installed in accordance with Section 26 0533.

G. All fire alarm system conduits and outlet boxes shall be marked and labeled.

H. T-tapped connections will not be allowed on any supervised circuits. Connections shall be directly to and from device terminal screws. Screw terminal shall have rising plates to terminate more than one wire or each wire shall be terminated to individual screws or each wire shall terminate in a ring lug.

1. Notification appliance circuits (NAC) shall be Class B.
2. Communication (initiating) circuits shall be Class A.

I. The location of smoke detectors in air ducts shall be as required by code and shall be accessible for maintenance. Duct smoke detectors shall be hard wired to shutdown associated air handlers.

J. Provide as-built wiring diagrams at completion of Project.

3.2 IDENTIFICATION

A. All junction box covers, conduit couplings and panels shall be painted red to match system manufacturer's hue.

B. Label all control and monitor modules and detectors with point numbers and function.

3.3 FIELD QUALITY CONTROL

A. Adjusting: After completion of system wiring, connect, test, adjust, and readjust as necessary, all equipment in terms of design function and performance.

1. Provide equipment to check the calibration of instruments. Instruments not in calibration, shall be recalibrated to function as required, or shall be replaced.
2. Calibrate and adjust devices, linkages, accessories, and components for stable and accurate operation to meet the design intent and to obtain optimum performance from the equipment. Final adjustment, calibration and checking shall be performed while the system is in full operation. Cause every device to automatically function as intended to insure its proper operation.

B. Demonstration: After calibration, adjustment, and checking have been completed and system is operational, demonstrate to the governing authorities having jurisdiction and to the Architect-Engineer the complete and correct functioning of all system components and equipment. These demonstrations shall consist of operating the controls through their normal full ranges and sequences. Simulate abnormal conditions to demonstrate proper functioning of the devices. Readjust settings to their correct design values and after sufficient time, observe ability of controls to establish the desired conditions, noting abnormal deviations. Make necessary repairs, replacements or adjustments on items which fail to perform satisfactorily and repeat tests to demonstrate compliance with the design intent.

1. When system is in specified operational condition, and when pertinent operational functions have been demonstrated, system will be accepted.

END OF SECTION 28 3111